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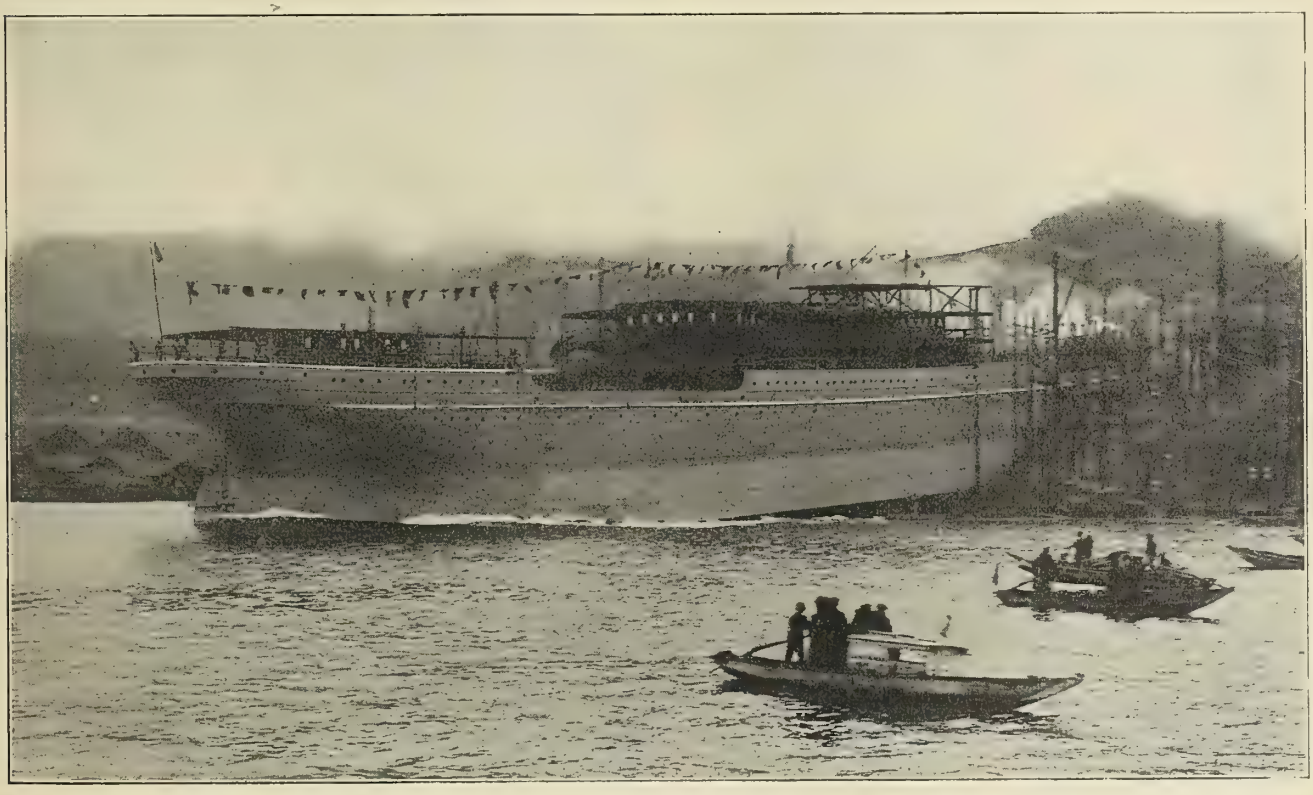
FOUR NEW TWIN-SCREW STEAMERS FOR THE NIPPON YUSEN KAISHA EUROPEAN LINE.

The *Kamo Maru, Hirano Maru, Atsuta Maru* and *Kitano Maru,* constructed by the Mitsu-Bishi Dockyard & Engine Works, Nagasaki, Japan, are the latest additions to the rapidly growing European line of the N. Y. K., and they are typical of the last 14 years' progress of this line.

The company is the outcome of the amalgamation of the Union Transportation Company (under the patronage of the government) and the Mitsu-Bishi Mail-Steamship Company (private concern) in 1885. At that time the business of the company was principally confined to the coasting trade, but, at the time of the amalgamation, the directors were requested by the Osaka cotton merchants to extend the company's trade to India on the ground that all the Indian cottons were imported by foreign steamers at high freight rates; consequently, the company established a Bombay line and entered into competition with the P. & O. Company.



LAUNCH OF THE KITANO MARU.

At the outbreak of the war between China and Japan all available steamers of the company were taken by the government for transports, and the company was forced to charter a few steamers from foreign owners to continue the China and India trade. However, at the close of the war, in 1895, all the steamers were returned to the company, bringing a considerable profit, and this profit was directed towards the development of the company, the first step being the construction of six new steamers of 6,000 tons each. Five of these steamers were built in foreign yards, but, in order to encourage the development of shipbuilding in Japan, the order for one of them was placed with the Mitsu Bishi Dockyard & Engine Works. Just at this time, the Japanese Government entered upon the policy of granting extensive subsidies to aid the shipping industry, and from this date the development of both shipping and shipbuilding increased very rapidly. The Nippon Yusen Kaisha immediately ordered six more steamships, and the subsequent remarkable development of the company is attributed largely to the good-will of the nation in granting liberal subsidies in spite of financial difficulties. Table I. shows a list of this company's steamers arranged in chronological order, and gives a good idea of the development of the company.

Table II. gives more fully the particulars for the new ships.

GENERAL ARRANGEMENT.

Entering now into the description of the vessels, they are constructed generally of steel to Lloyd's requirements of the

highest class, and are subdivided into eight compartments by watertight bulkheads, with a cellular double bottom from stem to stern. There are six decks, known as the lower, main, upper, bridge, promenade and boat decks. The lower deck extends through only the fore part of the vessel, while the next two decks, the main and upper, run from stem to stern. The bridge deck extends 178 feet in the central part, having a poop 80 feet long and a forecastle 54 feet long. Above this level there is in the central part of the ship the promenade deck, 138 feet long, and aft there is an aft boat deck, 56 feet long. The boat deck proper covers the entire length of the promenade deck, with the navigation bridge at the fore end.

At the fore end of the boat deck there are located the wheel house, chart room and captain's room, having a light and ventilating shaft for the main dining saloon, while around there is sufficient promenade room for the use of officers. Ten boats are stowed on this deck, affording a means of splendid promenade space on the deck below. The remaining boats are stowed on the aft boat deck, which also serves a means of minimizing interference with the promenade space on the poop deck. All boats are fitted with Mill's patent instantaneous engaging and disengaging gears. At the aft end of the boat deck there is the engine room skylight, also the clerestory skylight for the first class smoking room.

The promenade deck is interesting, because this deck is entirely allotted for the principal public rooms and the promenade space. There is a steel house extending almost the entire length, with a broad and spacious promenade around it, yet under the cover of the boat deck. The drawing room and social hall occupy the forward end of the house, having a companion way leading down to the bridge deck accommodation. The mid portion of the house is taken by the machinery, and at the aft end there is a first class smoking room, 24 feet by 28 feet.

The bridge deck is also used entirely for first class passenger accommodation. The deck house, which occupies practically the full length of the deck, has on each side staterooms of an exceptionally capacious and lofty character; to accommodate two persons in each. At the fore end of the house there is a large well, conveying light and air to the main dining saloon on the upper deck below. This light and ventilating well has been most ingeniously treated and serves to add to the decorative effect. This pierces the deck above through the drawing room and social hall, and through the boat deck house, and terminates with outer skylight on top of the navigation bridge; but in the boat deck house is a charmingly-designed stained glass dome of highly decorative character. Abaft the well there is a main stairway leading to the promenade deck above and to the dining saloon below. Ample natural light is provided in way of the staircase by means of a large and handsomely designed trunk skylight. At the aft end of this house there is companion way to the smoking room. The remaining space in this deck house has been devoted to bath rooms and lavatories.

The poop deck is given over to the second class passengers. There is a deck house on the poop, having at the forward end the second class smoking room, and at the aft the second class cabins, the latter adjacent to the companion way leading to the second class dining saloon and cabins below. One of the second class cabins on the poop deck is designed so that it may be easily turned into a wireless telegraph room, should occasion demand.

The forecastle deck is fitted with a strong breakwater, and carries the most approved equipment for handling the vessel safely and expeditiously.

The upper deck under the bridge deck contains a large number of cabins for officers and engineers; there is also the main dining saloon forward of these rooms; the first class pantry is immediately abaft it. Aft of the dining saloon there

TABLE I.

LIST OF N. Y. K. STEAMERS BUILT FOR EUROPEAN AND AMERICAN LINES.

Date of Launching.	Ship's Name.	Dimensions.	Gross Tonnage.	Speed.	Builder's Name.
1896	Kanagawa Maru.	445′ x 49′ 2″ x 33′ 6″	6,169	14.48	D. W. Henderson & Co.
1897	Hakata Maru.	445′ x 49′ 2″ x 33′ 6″	6,161	14.61	D. W. Henderson & Co.
1897	Kawachi Maru.	445′ x 49′ 2″ x 33′ 6″	6,101	14.80	Napier Shanks & Bell.
1897	Wakasa Maru.	445′ x 49′ 2″ x 33′ 6″	6,265	14.93	D. W. Henderson & Co.
1897	Kamakura Maru.	445′ x 49′ 2″ x 33′ 6″	6,126	15.43	Workman Clark & Co.
1897	Sanuki Maru.	445′ x 49′ 2″ x 33′ 6″	6,112	14.41	Napier Shanks & Bell.
1897	Inaba Maru.	445′ x 49′ 2″ x 33′ 6″	6,189	14.59	D. W. Henderson & Co.
1897	Tamba Maru.	445′ x 49′ 2″ x 33′ 6″	6,134	14.59	Napier Shanks & Bell.
1897	Bingo Maru.	445′ x 49′ 2″ x 33′ 6″	6,247	14.46	D. W. Henderson & Co.
1898	Hitachi Maru*.	445′ x 49′ 2″ x 33′ 6″	6,172	14.18	Mitsu-Bishi.
1898	Sado Maru†.	445′ x 49′ 2″ x 33′ 6″	6,227	15.30	Workman Clark & Co.
1899	Awa Maru.	445′ x 49′ 2″ x 33′ 6″	6,309	14.82	Mitsu-Bishi.
1900	Shinano Maru.	445′ x 49′ 2″ x 33′ 6″	6,388	15.39	D. W. Henderson & Co.
1901	Kaga Maru.	445′ x 49′ 2″ x 33′ 6″	6,301	15.51	Mitsu-Bishi.
1901	Iyo Maru.	445′ x 49′ 2″ x 33′ 6″	6,320	15.32	Mitsu-Bishi.
1903	Aki Maru.	445′ x 49′ 2″ x 33′ 6″	6,444	15.33	Mitsu-Bishi.
1905	Tango Maru.	445′ x 52′ x 33′ 6″	7,463	15.63	Mitsu-Bishi.
1906	Hitachi Maru.	445′ x 52′ x 33′ 6″	6,716	15.68	Mitsu-Bishi.
1908	Kamo Maru.	465′ x 56′ x 34′ 6″	8,524	16.41	Mitsu-Bishi.
1908	Hirano Maru.	465′ x 56′ x 34′ 6″	8,521	16.58	Mitsu-Bishi.
1908	Mishima Maru.	465′ x 56′ x 34′ 6″	8,500	16.56	Kawasaki Dockyard.
1908	Miyazaki Maru.	465′ x 56′ x 34′ 6″	8,500	16.35	Kawasaki Dockyard.
1908	Atsuta Maru.	465′ x 56′ x 34′ 6″	8,523	17.01	Mitsu-Bishi.
1909	Kitano Maru.	465′ x 56′ x 34′ 6″	8,512	17.19	Mitsu-Bishi.

* Sunk in Russo-Japanese war 1904.

† Torpedoed in Russo-Japanese war 1904, but repaired by Messrs. Mitsu-Bishi Dockyard & Engine Works.

TABLE II.

PRINCIPAL DIMENSIONS OF NEW SHIPS.

Name.	Kamo Maru.	Hirano Maru.	Atsuta Maru.	Kitano Maru.
Length between perpendiculars	465′	465′	465′	465′
Breadth molded	56′	56′	56′	56′
Depth molded	34′ 6″	34′ 6″	34′ 6″	34′ 6″
Gross tonnage	8,524	8,521	8,523	8,512
Draft	27′ 0¾″	27′ 0¾″	27′ 0¾″	27′ 0¾″
Dead weight	9,501	9,519	9,331	9,304
Speed	16.41	16.58	17.01	17.19
No. of first class passengers	83	83	83	83
No. of second class passengers	32	32	32	32
No. of intermediate passengers	12	12	12	12
No. of steerage passengers	138	138	122	124

[In *Atsuta Maru* and *Kitano Maru* a great many extra weights were worked into the vessels.]

are more staterooms, one of which is specially large and furnished superior to other staterooms, and may be styled as the cabin de luxe of the ship. There is also a photographic dark room on this deck.

The galleys are located at the aft end of the bridge house; all the arrangements for the serving of meals are modern and cuisine appliances are complete and up-to-date, but entirely free from the patent collections which are too often seen in modern steamers.

A point which draws our attention in the arrangement of this portion of the upper deck is that the starboard side of the ship is given up for chief steward, purser, doctor, dispensary, barber shop forward, and to officers' rooms aft; the corresponding cabins on the port side are arranged for officers' and engineers' mess rooms forward, and engineers' rooms aft. The first class passenger accommodation at the fore end of the house is divided off from these spaces by doorways, so that the officers and engineers are entirely separated from the passengers; and, moreover, for engineers the accommodations are contiguous to their work. The location of the doctor's room and dispensary is particularly good and convenient for all classes of passengers and crew, also the location of the barber shop, between the first and second class quarters, makes it convenient for both classes of passengers alike.

The deckhands are berthed forward under the forecastle, which is equipped in the most approved manner, while the dining saloon and cabins for the second class passengers, also cabins for the junior officers and laundry, are under the poop.

The lavatories are fitted with the most approved sanitary arrangements, and instead of being arranged in large compartments they are distributed throughout all the living quarters. The floors are laid with black and white encaustic tiles. All the baths for the first class passengers are of Vic-

torian porcelain. The sanitary appliances are supplied by Messrs. Shanks & Co., Ltd. The first class staterooms are fitted with patent berths, supplied by Messrs. Hoskin & Son, Ltd.

The intermediate and third class passengers are accommodated on the main deck forward, the firemen and waiters are berthed aft on the same deck; thus the firemen may go to the machinery space or back to their sleeping quarters without passing by any part of the ship given up to the passengers.

Aft the machinery space, a cold chamber has been provided; this chamber is not for carrying frozen cargo, as this is not necessary in this line of trade, but only for providing the fresh provisions for the ship. The chamber includes two meat rooms, one fish room and one fruit and vegetable room, and has a capacity of 2,800 cubic feet. The plant is capable of maintaining the temperature of the chamber at not over

READING ROOM ON THE ATSUTA MARU, LOOKING AFT.

26 degrees F., when passing through the tropics, with the machinery working not over 6 hours out of 24. It is at the same time capable of producing three hundredweight of ice for table use. The plant is supplied by Messrs. J. & E. Hall, Ltd.

The remaining part of the main deck is given up for cargo, bunkers, silk rooms, parcel room, mail room, baggage room and provision rooms.

The lower deck and holds are entirely given up for cargo.

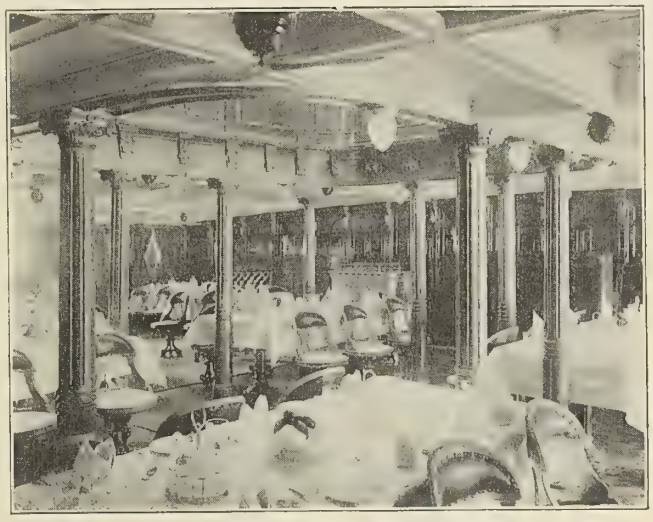
STERN FRAMING.

Referring again to the structural details of the vessel, the ship is propelled by twin screws, and these are supported at their outboard end by a cast steel spectacle piece attached to the stern frame. The shafting is contained entirely within the framing of the ship, and for this purpose the framing is bossed out in spectacle form. The stern frame has a screw port, as in the single screw arrangement, although the propellers are not of the overlapping design, but this is done to minimize the projection of the propellers outboard, which also minimizes the amount of bossing for the framing. A screw aperture for twin screws, with overlapping propellers, as we all know, was adopted first in the former Atlantic greyhounds *Teutonic* and *Majestic*, by Messrs. Harland & Wolff; nevertheless, in many instances, it is of greatest advantage to have this screw aperture with an ordinary twin-screw wheel, especially when the propellers are of large diameter, so as to reduce the resistance of the bossing.

The stern frames, spectacle pieces and rudders were supplied by Messrs. Darlington Forge Company, Ltd. The rudder is worked by a steam-steering gear, by Messrs. Caldwell & Company, Ltd. This gear is placed on the upper deck under the poop, and actuated from the navigation bridge; it is fitted with Hastie's patent friction brake. Hand gear is also fitted to the rudder head on the poop as a stand-by.

DECORATIVE FEATURES.

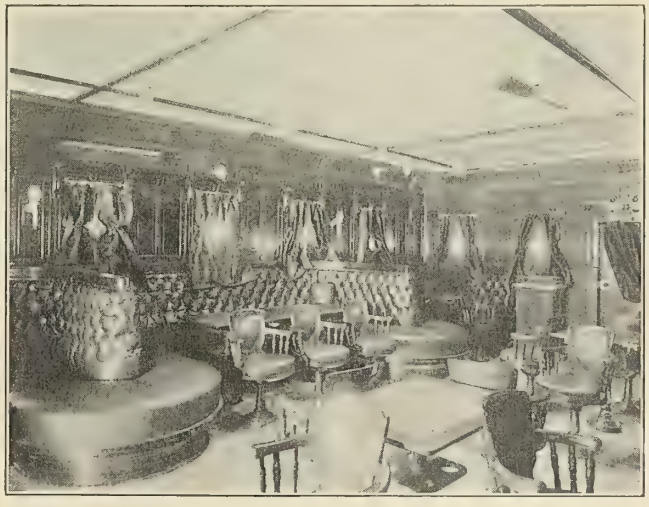
All four of these vessels were worked out alike in general decorative design, with but a slight modification. *Kamo* and



FIRST CLASS DINING SALOON OF THE KAMO MARU, LOOKING FORWARD.

Hirano are of the same design, and *Atsuta* and *Kitano* are of the same design, therefore in this case we will confine ourselves to a description of the *Atsuta Maru*. Before going any further, it may be well to say that all of the decorative work in these ships has been designed at the builder's works, where also the work was completed.

The first class drawing and social hall are adjacent to each other, and directly communicating with the main companion way. The drawing room is finished in white, relieved by pale green silk panels, with autumn wild flower design and with paneled dado of polished white beech. The furniture is of



FIRST CLASS SMOKING ROOM OF THE ATSUTA MARU.

white beech and maple, and the upholstery is of dark green silk damask; the curtains and other hangings are also of dark green. The floor is laid with Wilton carpet of green shade. A Broadwood grand piano occupies a corner in the drawing room. The side of the well is decorated with art-glass, in nickel-plated framework. The social hall is treated in exactly the same way as the drawing room.

The first class smoking room, at the aft end of the promenade deck, is treated after the old Japanese style, moderated to suit the modern European architecture with stained oak, and the floor is of interlocking rubber tiles. The upholstery is of dark maroon, and the hangings are of Japanese tapestry of subdued and quiet brown shade, with a classic pattern, becoming to the general design of the room. The roof is constructed in the clerestory style, with a large skylight having light-colored stained glass. The whole effect is very pleasing and in marked contrast to the somewhat garish decoration too often adopted in the modern steamer. The ventilation of the room, by means of electric fans, is very effective.

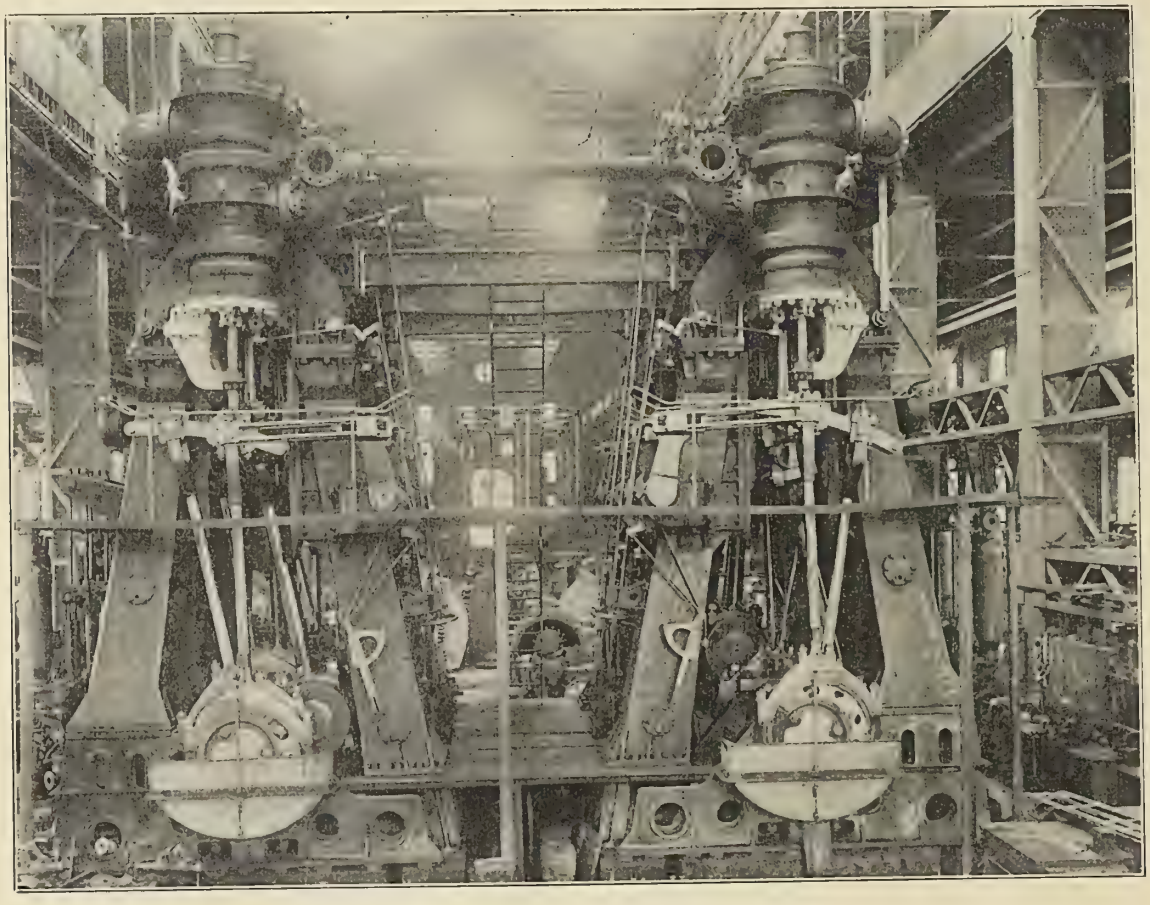
The first class dining saloon, which is on the upper deck, occupies the full width of the ship and is 32 feet long; seating accommodation is provided for 68 passengers, so that all the first class passengers may dine at one sitting. One commendable feature is that instead of placing the great majority of the passengers at long central tables, they are arranged, as in most modern liners, at a number of small tables, seating not more than seven persons. The saloon is finished with plain, polished oak, relieved with carved molding, the pillars being ornamented with carved head pieces. The upholstery is of dark green and the hangings are of gold on dark green ground. The floor is parquetted with brown Wilton runners on top. There is an upright piano of Broadwood make at the fore end of the saloon.

Electric fans have been substituted for punkahs over each table. The central well, while the main decorative feature, serves to further facilitate ventilation and has a length of 12 feet, and a width of about 9 feet, having at the top, as is already stated, a stained glass dome.

The vestibule on the promenade deck and entrance hall on the bridge deck are paneled and framed in oak, and the floors are covered with neatly designed interlocking rubber tiles.

ELECTRICAL INSTALLATION.

The generating plant is located in the tunnel recess and includes two sets, each giving an output of 35 kilowatts when running at 300 revolutions per minute. The engines are of the self-lubricating type, and the dynamos are six pole compound wound. The current is transmitted by insulated cable of high conductivity, all wiring done in the double wire distributing box system. These machines, in addition to lighting the ship, provide current for driving 13 36-inch ceiling fans for ventilating the first class dining saloon, 5 in the smoking room, 4 in the social hall, 4 in the drawing-room, 4 in the second class dining saloon, and 2 in the second class smoking-room. Also they drive 14 18-inch fans for ventilation of holds and 42 12-inch bracket fans for the first class cabins. There are throughout the ship lights equal to 8,022 candle power, and in addition 10 cargo lamps of 200 candle power each, 2 arc lamps of 3,000 candle power each, and one searchlight projector of 16,000 candle power. The main switchboard has 9 circuits, 6 for the lighting of the ship, 1 for the fan motors, and 1 for the search-light projector. The engines and dynamos, fan motors and all fittings for the installation are of the builder's own design and make, and fitted complete on the ships by the builder's own hands.



MAIN ENGINES OF THE ATSUTA MARU IN THE ERECTING SHOP.

As regards the telephone service, there is on the navigation bridge a telephone communicating with the engine-room, the lookout at the forecastle, and the docking orders at the aft boat deck. Telephones are of a pillar type and of the loud-speaking marine pattern of Graham's make.

While the vessel is finished as a first class passenger

steamer, the cargo carrying capacity of the vessel is of greatest importance in this line, and for dealing with the 6,000 odd tons of net cargo with facility and safety, the utmost attention and care have been exerted both by the owners and builders in the design and construction. Ten derricks are provided, four of 10 tons capacity, and the others of 6 tons. In addition to these there is fitted one heavy derrick capable of lifting 40 tons weight, with topping arrangement. This derrick is worked by two 9 by 16-inch steam winches working on one drum and one hoisting winch for topping worked by the messenger from the steam windlass. Besides these winches there are 8 steam winches for working other derricks. All winches are of the builder's special pattern and make.

The steam windlass with capstan is of Messrs. Napier Bros., Ltd.; it is fitted with the maker's patent self-holding brake. One steam warping capstan by Messrs. Clarke, Chapman & Company is also fitted on the poop.

Ship's telegraphs were supplied by Messrs. Chadburn & Son.

A complete system of water supply is distributed throughout the ship, maintaining the continuous supply of cold fresh water and hot and cold salt water, not only to all the sanitary quarters, but also to various galleys, pantries, sculleries, etc.

PROPELLING MACHINERY.

The vessel is fitted with a twin set of triple expansion engines, each set having the high-pressure cylinder 25 inches in diameter, the intermediate 41½ inches in diameter, and the low-pressure 69 inches in diameter; the stroke in all cases is 48 inches and the working steam pressure 200 pounds per square inch.

The high-pressure cylinder is fitted with piston valves, and the intermediate and low-pressure cylinders with slide valve, that of the intermediate-pressure cylinder being a special slide valve balanced, known as a square piston valve. The packing rings for the high-pressure and intermediate-pressure cylinders are of the Ramsbottom type, provided with restricted movements. The packing for the low-pressure cylinder is of simple design, so that spare springs may be easily procured.

Box columns are adopted, one of which forms a hot well and the air vessel of the air pump; others serve as reservoirs for lubricating oil.

The condenser is of strong cast iron, with rolled gunmetal tube plates, and tinned solid drawn brass tubes. The top of condenser is specially shaped so that the exhaust steam from the engine flows uniformly over all the tubes.

All the working parts of the engine are made to standard gage, so that the minimum of spare gearing is necessary. All the working parts of the engine are of ingot forged steel, while the propeller shafts are of patent lockfast iron.

The propellers are right and left handed screws, each with four blades, of Stone's manganese bronze. After a series of trials the propellers proved to be of the highest efficiency, and reflect the experience and ability of the designer.

AUXILIARY MACHINERY.

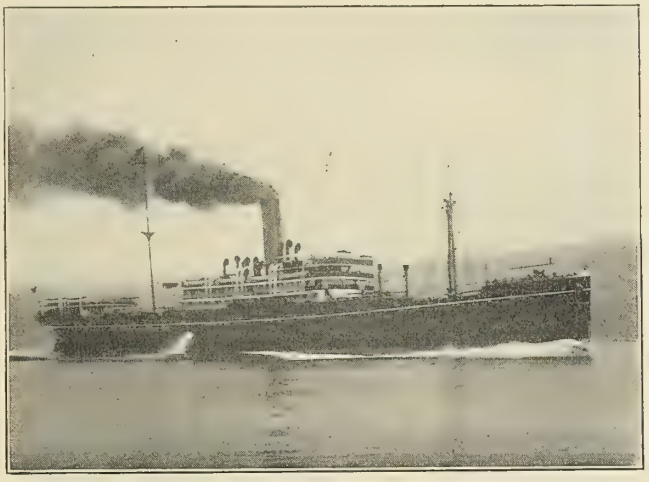
The various auxiliary appliances are as follows: Edwards' patent single acting air pump, Weir's patent feed heater and automatic pumps, circulating pump, feed water filter, auxiliary condenser of Morison's contraflo type, also pumps for sanitary purposes, for washing deck and fire extinguishing and for fresh water for passengers' use. There are also bilge and ballast pumps. The distilling plant consists of one large Weir's evaporator capable of producing from sea water 40 tons of fresh water per 24 hours, and one distilling condenser having an output of 7,000 gallons of pure fresh drinking water per day. The engine compartment, notwithstanding the completeness of all auxiliary appliances, is very roomy.

BOILERS.

The boilers are arranged in one compartment. There are six single-ended boilers; each boiler is 14 feet 3 inches in diameter and 11 feet 6 inches long. Each has three furnaces of the Morison bulb suspension type, the internal diameter of the flues being 3 feet 5 inches. The boilers are worked at a pressure of 200 pounds to the square inch, and are on the Howden's forced draft system.

Two fans are fitted, each having one special high speed single cylinder double acting engine of open type and capable of working all boilers when the main engines are running at 5,500 indicated horsepower on service.

There is one round, large funnel, 12 feet 9 inches in diameter and rising to a height of 110 feet above the keel of the vessel. The funnel is double, the space between the inner and outer funnels being utilized for ventilating the boiler room and stokeholds. The provision for the disposal of the ashes has been made by fitting two powerful See's ash ejectors, one in each stokehold, worked by a special donkey pump.



KITANO MARU RUNNING HER FULL SPEED TRIAL.

TRIALS.

In all cases the full speed trials were run on the measured three-mile government course outside of Nagasaki harbor under the supervision of the government officials. The following table gives the results of those runs:

MEAN RESULTS OF FULL SPEED TRIALS OF KAMO MARU, HIRANO MARU, ATSUTA MARU AND KITANO MARU.

Number of runs.	Kamo Maru 6 16 1908		Hirano Maru 11 16 1908		Atsuta Maru 2 15 1909.		Kitano Maru 4 12 1909.	
	Speed.	Revolutions.	Speed.	Revolutions.	Speed.	Revolutions.	Speed.	Revolutions
1 down.....	16.554	93.00	16.510	93.25	16.687	98.25	17 053	96.0
2 up.....	16.284	93.5	16.621	93.25	17.387	97.75	17.218	97.25
3 down.....	16.594	93.5	16.532	93.75	16.710	98.25	17.194	97.38
4 up.....	16.467	93.5	16.598	93.75	17.314	97.75	17.266	97.0
5 down.....	16.105	90.5	16.598	93.50	16.621	97.5	17.030	96.0
6 up.....	16.084	90.25	16.554	93.75	17.266	97.5	17.194	96.25
Mean of means	16.41		16.57		17.00		17.19	

Lastly, but most important above all, it is claimed that in service all the four vessels have proved themselves most economical in working and given every satisfaction to the owners.

The Bureau of Navigation reports 117 sail and steam vessels of 37,689 gross tons were built in the United States and officially numbered during the month of May, 1910. Seven steel steamers aggregating 25,679 gross tons were built on the Great Lakes, and two steel steamers, aggregating 6,741 gross tons, on the Atlantic coast.

THE MARINE STEAM ENGINE INDICATOR—XII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

The preliminary tests of the indicator being now completed, remove the pencil mechanism and piston; wrap in a soft cloth, and stow away in the indicator box. Plug the indicator cylinder with a piece of cloth; attach the instrument to its proper cock on the cylinder,[1] and line up the guide pulley so

FIG. 86.

that the drum cord will coincide with the center line of the reducing-motion guide rod, and in such position that the paper clips will face the operator as nearly as possible. Pass a cord through the guide pulley and around the drum base ring, just taking enough turns to rotate the drum its full amount, but still having sufficient to prevent the drum end of the cord being pulled inside of a line passing through the guide pulley and tangent to the drum base ring. See that the turns do not ride.

A light wire hook will be found in the box with the instrument. With a pair of round-nose pliers close the eye so that the cord will just pass through without binding. Attach the hook to the drum cord about an inch below the guide pulley by means of the hitch shown in Fig. 86, the part shown in dotted lines being omitted. Take another piece of cord and make a single bowline on the end (Fig. 87)[2]. Hook the bow-

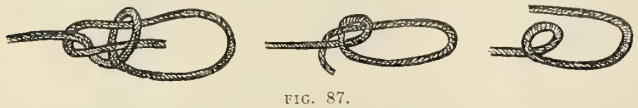


FIG. 87.

line in the hook. Put in the turning gear and place the engine on the top center. Pass the lower end of the bowline cord through the eye in the top of the reducing-motion guide rod, and haul the cord down until the drum is clear of the stop by about ⅜ inch; take an additional turn through the eye, and make fast with two half hitches about the standing part and draw the hitches down singly, so that there can be no slipping. See Fig. 88. Unhook the cord. Turn the engine to the bottom center and hook on again. If the reducing motion is properly proportioned, the hook will come down so that it will easily engage the bowline.

The testing out of the reducing motion is now in order. Take a long, wooden batten with a section about 1 inch by 1 inch and plane two of its adjacent sides. Secure a long wood screw in one end of the batten and grind or file the head down to a point. The engine now being on the bottom center, hold one of the planed edges of the batten against the end of the cross-head or gudgeon pin, in such a manner that it will be parallel to the piston rod, and with the pointed wood screw touching the cylinder bottom at whatever point happens to be in line. Note where the wood screw touches, and mark with a center punch. Put the screw end in the mark. Draw a fine horizontal line across the end of the cross-head pin, and make a corresponding mark across the batten. Turn the engine to the top center, and make another mark on the batten opposite the cross-head mark. Take the batten down, and divide the distance between the marks into any convenient number of equal parts. Not less than eight should be used, and these are conveniently laid off by successive halvings of the original distance.

Put a paper card on the drum, replace the pencil mechanism and piston, together with a light spring. Draw a horizontal line on the card by pulling the cord. Hook the cord in the bowline, and taking hold of the drum base ring with the fingers try to rotate it against the pull of the cord. This is done to make sure that the cord is all taut.

The engine being on the top center, make a small vertical mark on the card by gently raising the pencil about 1/16 inch with the pencil in contact with the paper. Put the batten in position, and turn the engine down until the first sub-division on the batten and the cross-head mark are in line. Make another small mark on the card. Repeat the operation until the

FIG. 88.

bottom center is reached. The diagram made will resemble Fig. 89, and if all is correct the spacing of the points will be equal. The small vertical line may now be projected upward, and the spacing checked with a diagonal scale, or a pair of fine-pointed dividers can be used. The distance x should be carefully measured and noted, and the diagram preserved for future reference. Much turning of the engine will be avoided if the operation of connecting up the drum cord is performed while the batten is being marked.

If it be necessary to rig the drum-cord with the engine in motion it is easily done as follows: Attach the hook and bowline as before described. Pass the lower end of the bowline-cord through the guide rod eye, and bring the end back in itself, holding the two parts together with the thumb and finger of one hand. With the other hand shorten up the cord until the drum is in motion and clears the stop at the top of the stroke. Now, very carefully shorten up the cord until the drum again touches the stop as the engine crosses the bottom center; slack the cord back half-way and make the round turn and two half-hitches.

Stretching or slipping of the cord is not admissible if accurate work is to be done, and if the cord lead is long, wire should be used for the entire transmission except over pulleys and around the drum; and even at these points some of the flexible bronze wires will stand for a considerable time. Ordinary soft iron wire—of No. 20 to 26 Birmingham gage—is good, and some of the small braided wire cords used for hanging pictures are excellent. If wire is used it should be drawn back and forth around one of the hand rails until all the kinks are worked out. The best fiber cord is made of parallel strands of linen, protected by a braided linen cover or jacket. It should be about 1/16 inch in diameter. Two or three days before indicating, several feet of cord should be stretched ready for use. This is best done by making one end fast up

* Copyright, 1910, by Chas. S. Root.

[1] The following description and directions refer to a vertical multiple-expansion engine fitted with a gear like that described in the April, 1910, issue.

[2] The reader should learn to tie these knots, as they will neither slip nor jam.

under the deck, running the cord along horizontally and over a small pulley or smooth ring at the free end, to which a 5 or 6-pound weight is made fast. If the cord is of good quality it will stretch about 1 inch in 16 feet, and no more. The stretching should be done in the engine room, where the atmospheric conditions will be about the same as when the cord is in use. While the writer prefers to use a hook with the double Blackwall hitch for adjusting the cord length, many operators like the trrangement shown in Fig. 90. If this is used the metal must be thick enough to permit of all the edges being nicely rounded. If the piece is thin, with sharp edges, the cord will be quickly cut, especially if the speed is high. The extra weight is also liable to cause vibration.

It will now be necessary to wait until the engine is under way, at full speed, before proceeding farther with our trials,

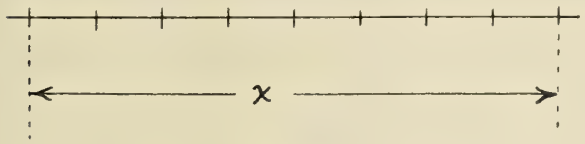


FIG. 89.

but in the meantime our cards should be made ready and the pencils put in order. Cards are of two kinds—"metallic" and plain. Metallic cards are coated with various preparations; some with a salt of lead and others with a coating of lime, whiting and size, and all of them present a fine, smooth surface. A brass or silver point drawn over a surface thus prepared leaves a fine, dark line, which is not easily erased. The surface is easily marked on with ordinary pencils, and takes ink well. The "pencil" used with this paper is simply a short piece of soft brass wire[3] worked down to a smooth, fine point. It requires some little patience to get the point so that it will draw a fine line and not catch in or scratch the paper, but once done it will last a long time. Metallic cards can be purchased from any indicator manufacturer. If plain paper is to be used a sample of the proper thing is furnished with the instrument.

FIG. 90.

When the original cards are exhausted a quantity of cards of the proper quality and size can be purchased at any printing house. They should be blank on both sides. The necessary data, to be used in working up the diagrams, are better kept in tabular form on a separate sheet, and the cards numbered for reference. With plain paper, HHHH leads should be used. They should be pointed with a fine file and be very short, so as to reduce the weight at the pencil end of the lever as much as possible.

There are several ways of putting the paper on the drum, but the writer prefers the following method: Place the paper, face upward, on a plane surface. Fold one end flat on itself, so that the crease will be about ½ inch from the end and square with the long edges of the card. Place the folded end of the paper under the end of the longer clip, in such a position that the fold will stick out radially from the drum. Still holding the folded end by its lower corner, wrap the card around the drum with the other hand, and shove its lower edge under the shorter clip. If the card is cut to the proper length both ends will now stick out about ½ inch between the clips. Bring the two lower edges together near the ends, and grasp them with the thumb and fore finger of one hand. Smooth the card on the drum with the other hand, at the same time drawing downward with both hands. If the original fold was not exactly square, one corner will be a little higher than the other, but that is immaterial so long as the paper lies smoothly

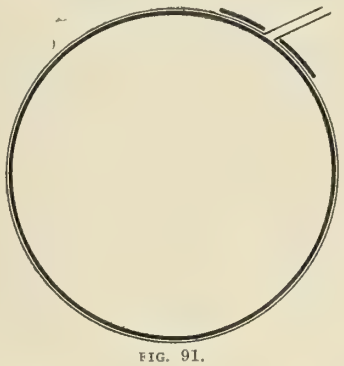


FIG. 91.

on the drum surface. A glance at Fig. 91 will make the description clearer. After ten minutes' practice the reader will be able to fit a card to the drum in a few seconds, so that it will be as close-fitting and smooth as could be desired.

The proper piston springs for the job on hand should now be selected, and as the spring is the actual measuring part of the instrument its accuracy and proper selection are of the greatest importance. If the springs which are about to be used are new, they will be correct or their error will be shown on a calibration card, which the maker will furnish if requested. If the springs have been in frequent use for a year they should be retested. If no material change is noted on this second test they may be allowed to go for a much longer period before the next calibration. The charge for spring testing varies from seventy-five cents to a dollar and a half (three to five shillings) for each spring. Fig. 92 shows a calibration

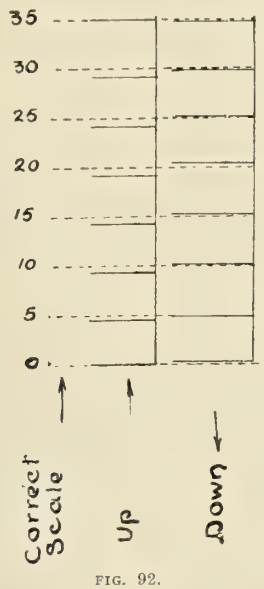


FIG. 92.

card of a 20-pound spring, which had been in use about three years previous to the test, and a glance at it will demonstrate that spring testing is not a useless refinement. The easiest cards to read are those whose height is equal to one-half the length, because in diagrams so proportioned the various events, such as cut-off, release, etc., are most sharply defined. In this connection it should be noted that the larger the card the smaller will be the percentage of error in measuring its area. To illustrate: Suppose that we have an engine working with a mean effective pressure of 40 pounds to the square

[3] A silver point makes a beautiful line, but it wears away faster than the brass.

inch, the reducing motion giving a card four inches long. If we take a diagram with a 20-pound spring its area will be 40/20 × 4, or 8 square inches. If a 40-pound spring is used its area will be 40/40 × 4, or 4 square inches. On the large diagram 1-pound pressure is represented by 8/40, or 1/5 square inch; on the small diagram 1 pound is equal to 4/40, or 1/10 square inch. If now a constant error of 1/5 square inch should be made in computing the area of both diagrams our mean pressure would be in error 1/5 ÷ 1/5, or 1 pound on the large diagram and 1/5 ÷ 1/10, or 2 pounds on the small diagram. On the other hand, the effects of inertia increase directly with the size of the diagram, and these should be kept in mind. A simple method for determining the magnitude of the error, due to drum inertia, will be described presently. The magnitude of the vertical distortions cannot be determined in so simple a manner. However, if the diagram does not show waves in lines which should be nearly horizontal, it may be assumed that the proper spring scale has been selected.

The reducing motion with which we are supposed to be working gives a diagram 3¾ inches long. This calls for a diagram 1⅞ inches high, but as our speed is 160 revolutions per minute, let us try 1½ inches for the maximum height. An approximate rule for finding the spring scale is as follows: From the receiver pressure, on the cylinder to be indicated, subtract the receiver pressure of the next following cylinder. Divide the result thus found by the desired height of the card in inches. Example: Let the receiver pressure be: high-pressure, 160; medium-pressure, 55; low-pressure, 16; condenser, —13 (or 26 inches vacuum). According to the rule the springs should be:

$$\text{High-pressure } \frac{160 - 55}{1.5} = 70$$

$$\text{Medium-pressure } \frac{55 - 15}{1.5} = 26.7$$

$$\text{Low-pressure } \frac{15 - (-13)}{1.5} = 18.7$$

We must now select the next nearest scale which is regularly made, and, in the case of the high-pressure, it should be generally the next higher. We should therefore try 80, 30 and 20, but no matter what result is obtained by the rule, springs should not be subjected to a pressure which will raise the pencil more than 2¼ inches above its position when at atmospheric pressure, and if a scale of maximum pressures is furnished with the instrument, such pressures should in no case be exceeded. Extracts from the tables of two indicator firms are shown on this page, and an inspection will show that they are practically the same.

While the 80, 30 and 20 springs which we have selected will probably be best for the job under consideration, our outfit should include the following for each set of three indicators: One each 10, 20, 30, 40, 60, 80 and 100 scale, and if our boilers are of the watertube type, carrying steam above 200 pounds, a 150-pound spring should be included.

(To be continued.)

MAXIMUM SAFE PRESSURES IN POUNDS PER SQUARE INCH WHEN USED WITH A HALF-INCH AREA PISTON.

Scale of Springs.	Duplex Springs.		Single Springs.	
	To 200 R.P.M.	To 300 R.P.M.	To 150 R.P.M.	To 300 R.P.M.
8	10	6	12	8
10	15	10	18	12
12	20	15	22	16
16	28	22	30	24
20	40	32	40	32
24	48	40	...	...
30	70	58	70	55
32	75	62	...	...
40	95	80	90	80
48	112	95	...	...
50	120	100	110	95
60	140	115	135	110
64	152	125	...	...
70	...	...	150	125
80	180	145	170	140
100	200	160	200	200
120	240	195	...	...
125	...	...	260	260
150	290	250	300	300
200	375	330	400	400

PERFORMANCE OF THE CREOLE.

The steamship *Creole*, of the Southern Pacific Company, has been an object of interest in maritime circles for several years past, because her machinery equipment as originally built was something of a novelty, differing from the customary practice in consisting of Curtis turbines for the propelling machinery, and Babcock & Wilcox boilers fitted with superheaters for the steam generating plant.

Recently the turbines have been removed and reciprocating engines fitted. The work of installing the new machinery was carried out by the William Cramp & Sons' Ship & Engine Building Company, the new equipment consisting of two vertical, inverted direct-acting, triple expansion, surface condpensing engines with cylinders 27¾, 46½ and 79 inches diameter by 42 inches stroke, designed for 95 revolutions per minute at a speed of 16 knots. The change from turbines to reciprocating engines was made because with the turbines the vessel was unable to make her schedule speed and proved uneconomical in coal consumption.

On May 14 and 15 the vessel was brought around from Cramps' Yard to the Southern Pacific Co.'s dock in New York, and, while no attempt was made to conduct a regular trial trip, observations of the performance of the engines and boilers were taken, with very satisfactory results. Advantage was taken of the convenient location of the measured mile at the Delaware breakwater, to standardize the screws, with the result that, without any attempt at forcing, a mean speed of over 16 knots was obtained, with a little over 7,000 horsepower. The vessel was, of course, not down to her load draft at this time, but the boilers were steaming so easily that there is no question but that the same speed can be obtained in full-load condition. It is especially to be noted, as showing the splendid workmanship on the machinery, that the vessel had not left the dock at Cramps until she went on this trip, so that the performance attained was during the first time the engines had been operated in free route.

The vessel sailed from New York May 25 in her regular passenger service between New York and New Orleans and arrived at South Pass, mouth of Mississippi river, at 7:58 P. M., May 29, 6 hours ahead of schedule. On the return trip the vessel sailed from New Orleans June 1 at 10:10 A. M. and arrived in New York at 3:00 P. M., June 5, 16 hours ahead of schedule and breaking all north-bound records between the two ports. The run south bound, bar to bar, was made in 103 hours 15 minutes, despite the fact that the vessel lost 2 hours 45 minutes between Scotland Light and Diamond Shoal on account of being operated at reduced speed in dense fog. The run, north bound, bar to bar, was made in 92 hours 20 minutes. The average speed over the bottom, bar to bar both ways, was 16.55 knots, and the vessel was fully loaded both ways, so that conditions were thoroughly normal.

When the turbines were in the ship, statements were made to the effect that the boilers could not supply sufficient steam, but on this trip, with the reciprocating engines, the fire room staff had a very easy time, and it was almost constantly necessary to check the draft to keep from raising the safety

valves. Indeed, the boiler plant is so ample that we understand the management will experiment with the use of less than the full number of boilers. The vessel's boiler equipment is the same as originally installed, i. e., 10 Babcock & Wilcox large tube type marine boilers carrying a working pressure of 210 pounds above atmosphere with 50 degrees Fahrenheit superheat. On her first trip the vessel was operated with the usual complement of men in the engine department taken from the line's regular service.

Altogether this history of the Creole is most interesting, and we hope that when there has been time for the crew to become thoroughly accustomed to the machinery, the management may see their way clear to make some careful tests with a view to determine the economy.

As far as the experience on this ship goes, it certainly tends to prove that a 16-knot vessel is not a proper place for the application of the direct-connected turbine. Indeed, we believe that Mr. Parsons is on record as not advising the use of turbines for lower speeds than about 18 knots.

The completion of the government collier, which is to be fitted with turbines operating through the Melville & Macalpine reduction gear, will be awaited with great interest, because the claim is made for this combination that both turbine and propeller will be used under conditions of maximum economy, and the gear itself on its shop tests has shown such a high efficiency that this combination ought to give an extremely economical result.

THE UNITED STATES NAVAL SCHOOL OF MARINE ENGINEERING.

Readers of International Marine Engineering will feel much personal pride in the recent establishment of a post-graduate school of marine engineering at the U. S. Naval Academy, Annapolis, Md. To the true friends of the navy who occupy positions of responsibility in civil life is due in great measure the success of the plan adopted in 1899 for amalgamating the engineer and line officers in the navy. This post-graduate school of marine engineering is the concrete development of that plan.

Since 1899 the Naval Academy has been developing along engineering lines until the Secretary of the Navy states that it is now one of the best technical schools in the country, and that its graduates are fitted to undertake subordinate engineering duties of all sorts, but he adds that their general education, even with the practical experience gained after graduation has not qualified officers for the important work of designing the machinery of our naval vessels. Since the passage of the Personnel law, in 1899, a measure which was actively urged to passage by International Marine Engineering, line officers and engineer officers of the navy have been fused into a co-ordinating unit, until now it is scarcely possible to find any officer of much length of service that has not had a considerable amount of both sorts of duty. As the Secretary states, naval officers in their manifold duties, whether in the engine room, in turrets, at the guns, whether handling electricity or training men, are constantly in charge of the operation of complicated machinery, and it may be said that they have continuous engineering duties.

The school of marine engineering was established with two primary objects in view:

First.—To stimulate general interest in engineering matters throughout the navy.

Second.—To provide competent designing engineers for the future.

The students of the school are limited in number to 20, 10 being selected each year from applicants for that duty from the line officers of the service below the rank of lieutenant-commander. The basis of selection, as announced by the department, is engineering ability, combined with evinced knowledge and ambition. The students are chosen solely according to their records of service and performance, and are a representative group of officers. In short, the school is a post-graduate honor course for officers who have served at sea for at least three years, and who have distinguished themselves among their fellows by superior engineering ability and qualifications. It is understood that the ten students selected for the first class now at the school were chosen from about 200 applicants for this duty among the younger officers of the line of the navy. Evidently where there is a general desire to improve in engineering knowledge the establishment of this school, by holding out a reward to the younger officers of the navy, will serve to accomplish its first object, namely, the stimulation of general interest in engineering matters throughout the navy.

Our readers will be particularly interested in the unique method of instruction that has been adopted at the school and in the exceptional conditions that have rendered the methods used applicable to naval conditions.

In the first place, the curriculum is peculiar. There are no professors or instructors at the school. One officer, Lieutenant-Commander Milton E. Reed, an experienced engineer, is detailed to the school as its technical head. There is in the school a considerable library of engineering books, and these have been carefully card-indexed under the various headings. A large number of engineering periodicals are regularly received at the school, and these also are indexed, in order that the latest information on engineering subjects may be readily at hand for reference.

In view of the methods by which the student officers of this school are chosen, little attempt is made to impose upon them a fixed curriculum, the head of the school acting more as a guide to the students than an instructor. The students are required to familiarize themselves with the fundamental principles and underlying ideas of everything in engineering that is requisite to a complete knowledge of marine engineering design.

For example, certain specified courses of reading are furnished the student officers concerning mechanical engineering, electrical engineering, ordnance engineering, hydraulic engineering, naval architecture, chemistry, works management, etc. This course has been so elected and extended as to require normally about four hours of reading each day by each officer.

Facilities are given at the Naval Academy to the students of the School of Marine Engineering for original experimental engineering investigation in three large engineering laboratories; the marine engineering laboratory of the Naval Academy, in which most of the mechanical appliances used in any way in the navy are exhibited, and in which these appliances may be tested; the electric laboratory of the Naval Academy, in which samples of all electrical apparatus used in the navy are set up, and in which they are tested, and the naval experiment station, likewise at Annapolis, in which experiments are regularly conducted on a large scale to determine questions of imminent interest to naval engineers.

It is not expected nor intended by the Navy Department, in the preparation of the curriculum for the school, that the foregoing work shall completely cover the post-graduate education to be given the student officers. Ample opportunity is given to them to develop ideas or methods that they may originate or elaborate leading to better efficiency, design, economy, maintenance or operation.

In addition to the foregoing a valuable feature of the course of instruction has been a series of lectures given by some of the most eminent experts in the country. These

gentlemen have appeared before the school and have delivered lectures upon the special engineering subjects with which they were most familiar, and in which they had achieved success. They have, in every case, been invited to criticise freely naval practices, and have been requested to dvelop, so far as possible, any weakness of naval engineering. In this way the student officers have come in personal contact with some of the leaders in the engineering profession. In many instances they have established friendships that will continue throughout the years, enabling them to acquire successful commercial methods and infuse them into naval designs and practices.

The most valuable educational feature of the course of instruction is provided by arranging that the student officers shall make a summer tour among the representative productive establishments of the country. For the purpose of these visits, representatives among the corporations in the Middle West and Eastern States have voluntarily tendered the freedom of their shops and plants, and ample evidence is shown that the navy and engineering in the navy is not lacking of real friends, and that commercialism does not overrule patriotism. In some of these plants special courses of lectures to the student officers at the works have been arranged by the managers. Such observations and study of commercial work and management as these visits will afford will present many comparisons which the student officer will be able to build into his future work to place ships and naval stations on an efficient and economical basis.

In addition to the work done at the school each student officer is required to submit annually to the head of the school a thesis on some engineering subject, the subject to be of his own selection and to be treated according to his own views.

The course of advanced instruction at the school of marine engineering is of two years' duration. Of this course twelve months are to be spent at the Naval Academy, eight months on visits to the commercial establishments, and four months in the study of practical designing at the Navy Department. At the completion of this course it is contemplated, in the order establishing the school, that the graduate officers will be assigned for a short time to shore duty, either in the inspection of material, in the inspection of construction of machinery, or in the actual work of repairing and overhauling naval vessels. At the end of this short period these officers will be assigned in their turn to engineering duty at sea.

In this capacity it is evident that they will disseminate throughout the service by their contact with their ship-mates, assistants and subordinates much of the general engineering knowledge that they have obtained.

From the graduates of the school it is contemplated that two officers shall be selected annually for duty as designing engineers. Normally these selections will not be made until the officers have performed two years of duty after their graduation from the School of Marine Engineering, and not until they have definitely fixed their purpose to develop themselves along engineering lines and clearly demonstrated their exceptional ability as naval engineers.

The number of these officers reserved for designing engineering duty is limited by the order of the Navy Department to twenty.

It is a pleasure to see in the plan underlying the foundation of the School of Marine Engineering, prospects for the continuation of the upbuilding of marine engineering in the navy, and for the creditable continuation of the records of such naval engineers as Haswell, Isherwood, Melville and others who have marked their time with bold strokes of progress and resourcefulness.

The method of post-graduate instruction outlined here might not be generally successful, but it seems to have been adopted with special reference to the mode of selection and the assured individuality of the students at the school. The advanced education being a reward of merit, restrictions of the field of education are not needed and are not made. The engineering world will watch this school with interest, and if the system is successful a similar one is evidently a good means of increasing efficiency in our large engineering institutions.

Launch of an Australian Destroyer.

Coincident with the launching of the battleship *Colossus*, by the Scott's Shipbuilding & Engineering Company, Greenock, Messrs. William Denny & Bros., Dumbarton, launched the Australian torpedo boat destroyer *Yarra*. This is one of three destroyers, contracts for which were placed in England by the Commonwealth of Australia in April, 1909.

These boats are all named after Australian rivers. They are of the first British "River" class, with improvements in arrangement and in machinery. This type was developed from the 30-knot vessels, whose speed was obtained under abnormal conditions.

The destroyer committee appointed by the Admiralty found that the 30-knot class were strong enough for seagoing work, but that the real speed limit in a seaway was not reached in strength, but in the amount of driving which the vessel could stand. In the new "River" class a forecastle was adopted and in all the later destroyers. The "River" class are strong, able, sea-keeping vessels. The Australian government adopted this type for their destroyers, everything being done to avoid structural breakdown of the most unimportant kind.

The *Yarra* has watertube boilers and reciprocating engines, and will obtain a speed of 25½ knots with a full seagoing load. Her dimensions are: Length, 245½ feet; breadth, 24 feet 3 inches; displacement, 700 tons. She is fitted with turbine machinery, and steam is raised by oil fuel. Her Admiralty conditions are 26 knots, but for a larger field of operations the radius of action has been increased above that of the British type, and she will carry enough oil to steam 2,500 nautical miles.

The armament consists of one 4-inch, three 12-pounders and three 18-inch torpedo tubes. The crew numbers sixty-six.

She is built of high tensile steel, and follows the practice of the British Admiralty in all structural details of hull for the "River" class of vessel. In the officers' and crew's quarters there has been a new arrangement following that recently made in the battleships. The officers are forward, immediately under the chart-house and bridge on the forecastle, while the crew are partly underneath the officers' accommodation and partly aft.

Publications Issued by the Steamboat Inspection Serice.

As a part of the valuable service rendered to the marine interests of America by the Steamboat Inspection Service, the following publications can be had by any of our readers upon application to the Supervising Inspector General of the Steamboat Inspection Service, Department of Commerce and Labor, Washington, D. C.: "General Rules and Regulations Prescribed by the Board of Supervising Inspectors"; "List of Licensed Officers of Merchant, Steam, Motor and Sail Vessels"; "Laws Governing the Steamboat Inspection Service"; "Pilot Rules for the Great Lakes and Their Connecting and Tributary Waters"; "Pilot Rules for the Rivers whose Waters Flow into the Gulf of Mexico and the Red River of the North"; "Annual Report of the Supervising Inspector General, Steamboat Inspection Service"; "Pilot Rules for the Atlantic and Pacific Coasts and Gulf of Mexico."

THE LATEST TURBINE DESTROYERS OF THE FRENCH NAVY.

Up to the last few years the French Navy has remained far behind the leading naval powers in the use of turbines, whereas in former times France has taken the lead in certain lines of naval progress, such as in submarine navigation. In 1906, however, the French Admiralty decided to follow the trend of progress, and turbine engines were ordered for the six battleships of the *Danton* class (18,000 tons). The experience of other naval powers, added to the very favorable reports of the French naval experts upon their return from a visit to the famous English *Dreadnought*, decided the Admiralty to accept Parsons' turbines. At that time the Admiralty could not have made a better choice, as the adoption of this type of machinery for the largest vessels was well known all over the world, but later on, following the example of the United States and Germany, the French Admiralty decided to carry out new experiemnts on smaller boats, such as destroyers, which are well suited for experimental purposes.

The destroyers then in service (1906) did not answer the needs of a modern fleet, as they were really too small to contend with the 800 and 900-ton destroyers of the neighboring nations. Therefore, the leading shipbuilders in France were asked to submit their best proposals for a number of destroyers, to be immediately constructed according to the following general specifications:

Armament.—Six 2.56-inch quick-firing guns, three to fire ahead and three astern. Ammunition, 2,100 shells.

Torpedo Tubes.—Three 18-inch, one in the stem. Ammunition, six torpedoes.

Machinery.—Four watertube boilers in two watertight compartments. Main engines located in separate watertight compartments.

Speed.—Twenty-eight knots for one hour, 24 knots for the four following hours.

Steaming Radius.—1,170 miles at 14 knots. Sufficient fuel for this distance to be carried on the full-power trials.

Steering Radius.—400 yards maximum.

The plans for six different types of vessels, according to the foregoing specifications, were accepted, and each of the designer's firms received an order for one or more boats.

These destroyers are to be divided into two classes: First, those driven by reciprocating engines; second, those driven either by turbines or by reciprocating engines combined with turbines.

FIG. 2.—STERN OF THE VOLTIGEUR.

So far the *Carabinier* is the only boat of the first class which has given good results on official trials. She was built by the well-known firm Chantiers & Ateliers de St. Nazaire, at their Rouen yard. The other boats have not yet been accepted, and will have their machinery altered, according to orders just received by the Admiralty. The forced lubrica-

FIG. 1.—DESTROYER VOLTIGEUR ON THE WAYS.

It was also required that the boats should be capable of stopping within a distance of 250 yards when steaming at 20 knots. Wireless apparatus and a special room for its auxiliaries was to be fitted.

tion system is to be completely removed, and ordinary apparatus fitted.

The second class is the most interesting. It is composed of the following destroyers: *Chasseur,* built by A. Normand & Company, Havre, Parsons turbines built by Compagnie Electro-Mecanique; *Voltigeur,* built by Ateliers & Chantiers de Bretagne (formerly de la Brosse & Fouché), Nantes, equipped with reciprocating engines and Rateau turbines; *Tirailleur,* built by Chantiers & Ateliers, de la Gironde, Bordeaux, equipped with reciprocating engines and Breguet turbines; *S. T.,* built by Schneider & Company, Le Creusot, equipped with Schneider-Zoelly turbines.

The main particulars of these destroyers are given in the appended table.

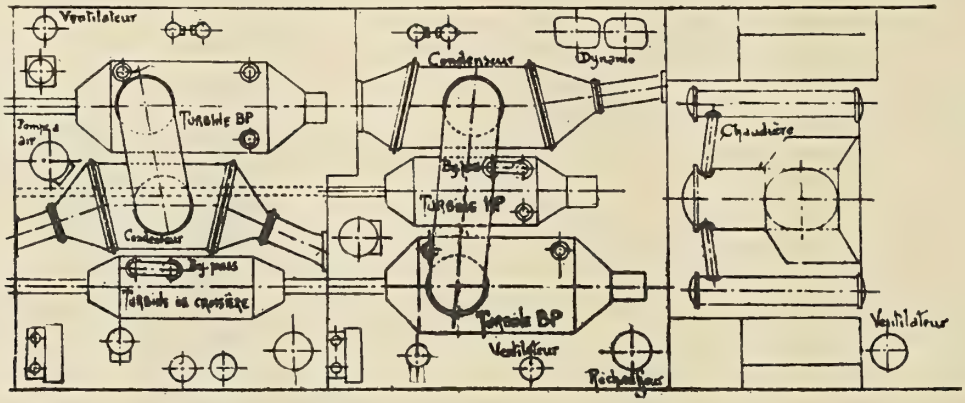


FIG. 3.—ARRANGEMENT OF TURBINES ON THE CHASSEUR.

CHASSEUR.

The theory and details of construction of the Parsons marine turbine are too well known to need any description at this time. On this destroyer four main turbines are used for going ahead, three for full speed and one for cruising. Steam at full boiler pressure is admitted directly into the high-pressure turbine, driving the central shaft. Then the steam is expanded into two low-pressure turbines at the wings, whence it goes to the condenser. The turbines for this vessel have been designed to develop 7,200 horsepower at 850 revolutions per minute, giving the boat a speed of 28 knots.

At normal speed, steam is admitted directly into the high-pressure turbine, but, if necessary, the power may be increased by the opening of a by-pass valve, which admits steam under full pressure into the second stage of the turbine.

Steam from the main steam pipe is admitted to the cruising turbine which drives the starboard propeller, mounted on a hollow shaft, which extends through the starboard shaft and operates without friction. Suitable means of connection are produced between the two shafts, and a small clearance is allowed in order to allow for expansion, due to heat. For slow speed, the cruising turbine is coupled up and steam admitted to it; thus the starboard propeller runs ahead. Steam is exhausted from the cruising turbine to the central high-pressure turbine, and from there passes to the two low-pressure turbines, and is finally exhausted to the condensers. The power of the starboard low-pressure turbine is thus added to that of the cruising turbine, so that from 8 to 16 knots' speed can be easily obtained by this combination and 18 knots' speed may be obtained by opening the by-pass valve, which admits full steam pressure into the second stage of the cruising turbine.

The astern turbines are mounted on the wing shafts only, and they are incorporated in the same casings with the low-pressure ahead turbines. Maneuvering is accomplished by the use of the wing propellers, the central turbine remaining idle.

VOLTIGEUR.

The *Voltigeur* is the first vessel equipped with Rateau turbines, and, therefore, its success is of particular interest. The Rateau turbine as improved by the Ateliers & Chantiers de Bretagne is now called the Rateau-Chantiers de Bretagne marine turbine. It is of the axial multiple stage type, combining the features of the impulse and reaction turbines. The advantages claimed for this type are that the lateral pressure on the wheels or moving disks is eliminated and the moving parts can be given considerable play in a radial direction, thus allowing easy fitting and regulation. The clearance between the shaft and the diaphragm alone is important, consequently it is reduced to .04 inch, which can readily be done owing to the small diameter of the shaft. In the latest type of Rateau-Chantiers de Bretagne marine turbine, now building for the destroyer *Fourche* and *Faux,* inside leakages of steam are completely stopped.

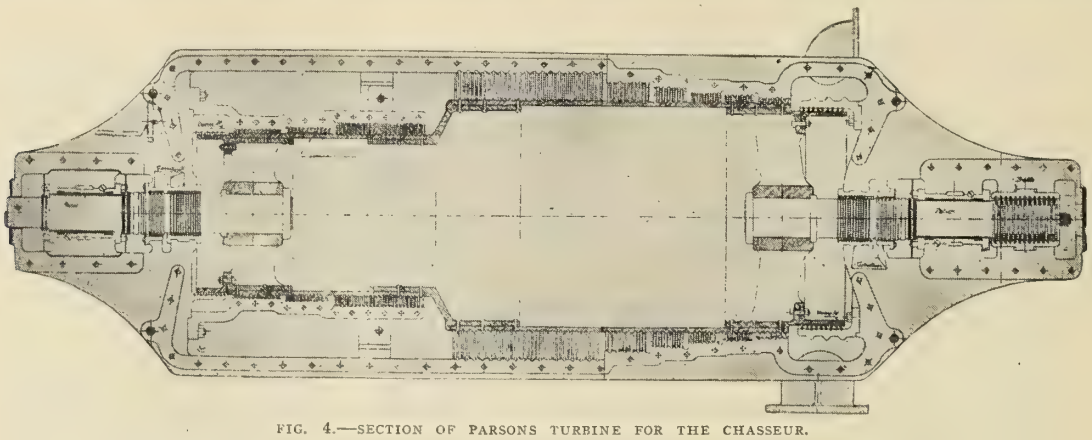


FIG. 4.—SECTION OF PARSONS TURBINE FOR THE CHASSEUR.

The diaphragms are fitted tightly in the stator, or casing, and packing is fitted around the shaft, a matter of considerable advantage in the high-pressure turbine, where the difference in pressure is more important.

The ahead and astern turbines are mounted on the same shaft and located in the same casing. Each of them may be divided into two different parts—the high-pressure and the low-pressure. The high-pressure part is built on the multiple disk principle, and has been calculated for economical running

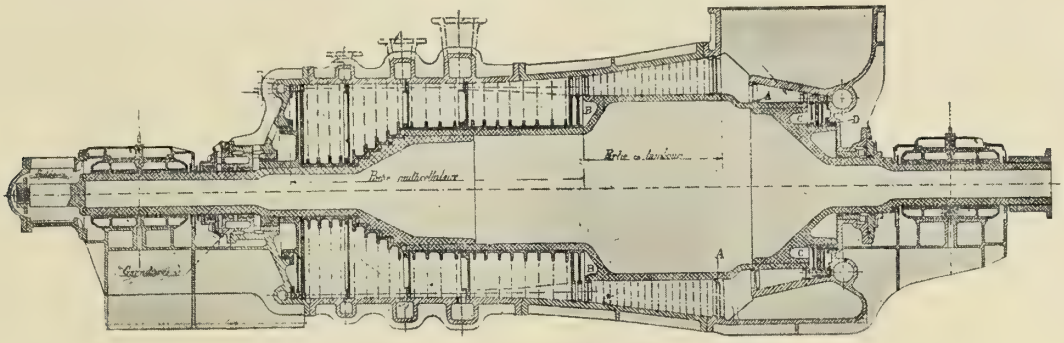


FIG. 5.—SECTION OF RATEAU TURBINE FOR THE FOURCHE.

whatever variation may be required in speed and power. The low-pressure part is mounted on a drum which gives equilibrium and counterbalances the thrust of the propeller. The pressure in each stage being low and the clearance very small, if compared with the large section of the passage in the nozzles, there is little need of guarding against steam leakage in the stationary vanes.

Steam is admitted to the turbine at several points, each of which corresponds to a different speed. The smallest power gives the longest expansion. The passage from slow speed to high speed is obtained through a single valve. The intermediate speeds are obtained by reducing the opening of the steam valve to throttle down the pressure. The astern turbines are built on the same principle as the ahead turbine, but they are calculated to give only about 40 percent of the power of the former. As has already been stated, the thrust of the propeller when running either ahead or astern is counterbalanced by the low-pressure turbine, which has been especially designed for this purpose. A thrust block attached to the forward end of the shaft absorbs any slight differences that might occur, and at the same time assures a perfect alinement of the moving disks between the stationary blades.

There are several points of interest in connection with the construction of these turbines which are worth while noting. The stator, or casing, is cylindrical, of cast iron and is divided through its length into a series of separate compartments by diaphragms in order to facilitate the construction. It is also divided horizontally into two parts in order to allow the rotor to be laid aside. When fitted together, however, the casing is perfectly tight. The necessary ports for the admission and exhaust of steam, as well as for the relief valves, etc., are cast in the casing.

The diaphragms, dividing the stator, are all of cast steel, each in two pieces and fitted in grooves, made in the casing. Around their periphery they carry the boxes containing the stationary blades.

The diameter of the shaft is not uniform throughout its length, but varies according to the weight of the rotor. At the stuffing boxes it is reduced to a minimum. Labyrinth packing is provided at the ends of the casing and any steam which leaks through is returned to the turbine through a special nozzle. Forced lubrication is used and the bearings are water-cooled.

The shaft is of hollow steel, carefully machined inside and out, in order to obtain a perfect balance as well as to facilitate the dismounting of the wheels and the centering of the wheels in the diaphragm. The moving wheels or disks are made of forged steel, machined on all sides and carefully balanced and

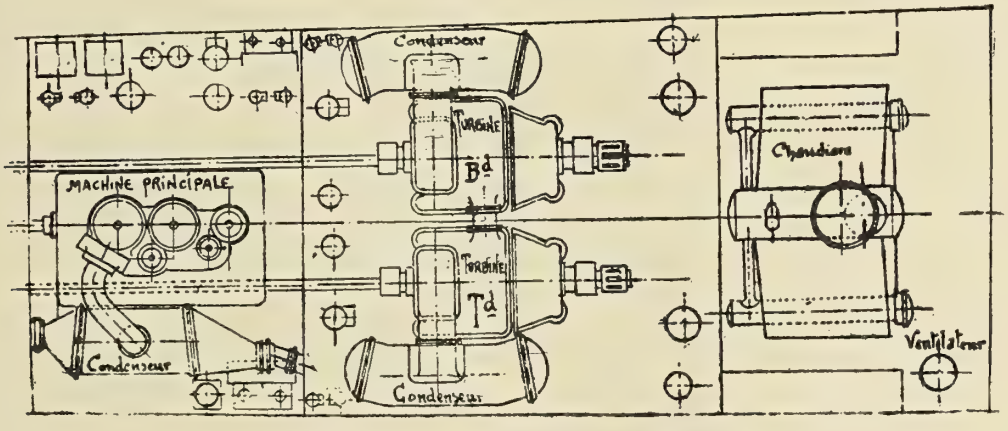


FIG. 6.—MACHINERY ARRANGEMENT OF THE VOLTIGUER.

fastened with keys on the shaft. The blades are of special drawn brass and are erected on the drums and wheels in dovetail grooves. The correct interval is obtained by using an intermediate filling block as shown in Fig. 7. A small projection flanged at the foot of the blade extends into the filling blocks and thus gives the whole an exceptional resistance to tearing off. Two cuts are made in each wheel to give the necessary passage for the blades to enter into the groove. After the blades have been erected, they are encircled with a metallic channel-riveted ribbon to obtain regular intervals between the upper edges of the blades and to increase the

strength of the whole. Due to this construction, great solidity is obtained without welding or calking. Before the final erection of the shaft, each wheel is separately tested on a special engine at a speed equal to twice the maximum speed in service. The stationary blades are made of the same material, and are erected in the diaphragms in practically the same way as the moving blades. At one end each blade carries a strip, allowing it to be fastened by means of rivets to the two brass plates, *C* and *D* (Fig. 7).

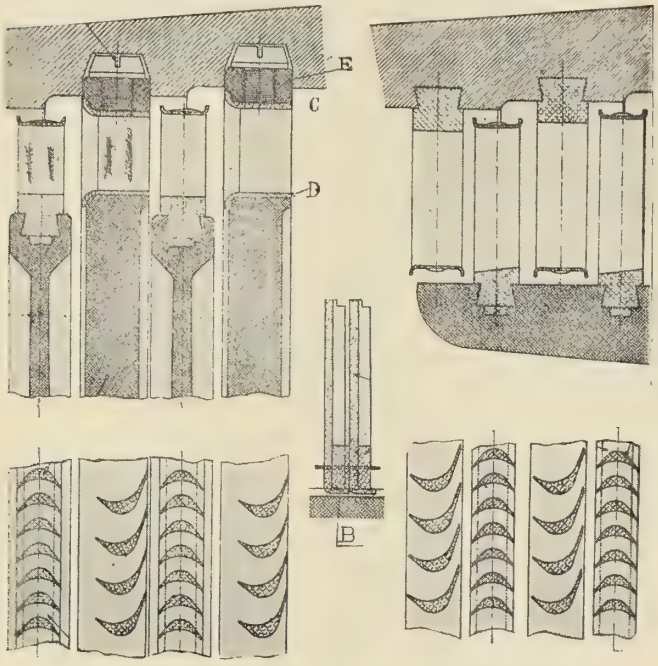


FIG. 7.—DETAILS OF CONSTRUCTION OF RATEAU TURBINE.

The main engines of the *Voltigeur* consist of a three-cylinder triple expansion reciprocating engine working on the center shaft and two Rateau-Chantiers de Bretagne marine turbines on the wing shafts. The main particulars of the reciprocating engine are included in the appended table. This engine exhausts either into the condenser or into the turbines according to the speed required. This engine is the first of its type designed and built by the Ateliers & Chantiers de Bretagne. It is of the inclosed type, with special forced lubrication. It is without steam jackets except on the covers.

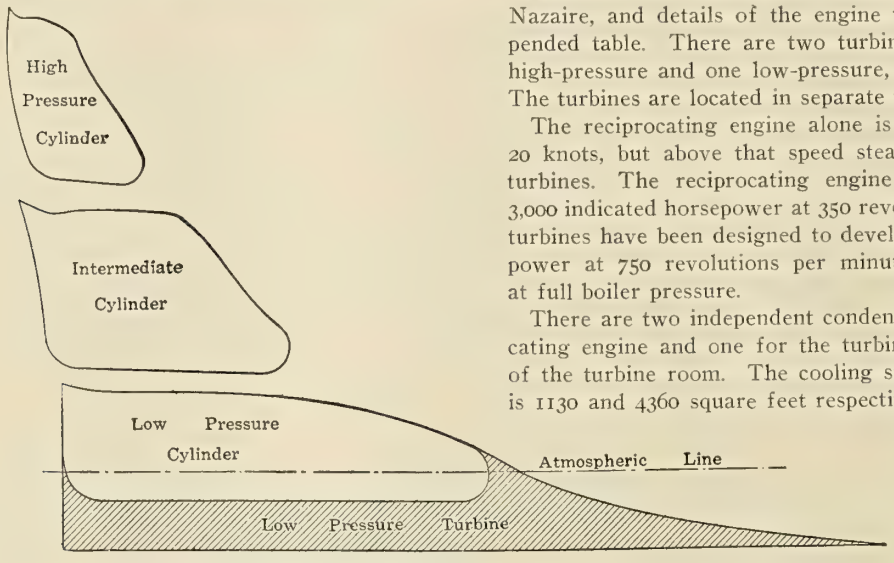


FIG. 8.—COMBINED INDICATOR DIAGRAMS OF TRIPLE EXPANSION RECIPROCATING ENGINE AND TURBINE. SHADED PORTION SHOWS WORK DONE BY TURBINE.

The two turbines are located in a watertight compartment. Each turbine has been designed to develop 3,000 horsepower at 850 revolutions per minute. All movements of the engines are easily controlled from the starting platform, and it is claimed that maneuvering is as easy as with two reciprocating engines. When going ahead the propellers turn outboard.

The reciprocating engine may be used alone up to 20 knots, but there is very great advantage in exhausting steam to the turbines. By doing so the back pressure from the low-pressure cylinder of the reciprocating engine is permitted to act practically upon a piston of indefinite area, so that considerably more power can be obtained, as shown by the shaded portion in the indicator diagram shown in Fig. 8. Also, by this method the resistance of the idle propellers connected to the turbines is avoided. Such resistance is very important at 12 knots' speed and above.

TIRAILLEUR.

The turbines fitted on the dstroyer *Tirailleur* are the second set adopted by the Breguet firm to the propulsion of ships, the first one having been installed in the torpedo boat No. 294, which is now a schoolship for pilots, firemen and engineers who are specializing in torpedo boat navigation. The Breguet turbine is of the impulse type, and the difference in construction between it and the Rateau turbine consists in the fact that the blades are of the De Laval type, and calculated according to that pattern. They are made of high tensile bronze, cold drawn, and cut in length in the same direction as the metal was rolled. The fixed and moving blades are dovetailed into slots made in the annular part of the casing, or the outer part of the wheels and drums and are riveted into place. It is also worthy of note that the fixed blades have a connection at their outer ends, so that they are strongly fastened one to the other in such a maner as to form a compact block. This is of great importance because it avoids any vibration.

The machinery arrangement on the *Tirailleur* is as follows: In the compartment immediately aft the second boiler room there is a reciprocating, triple expansion engine of the inclosed type working under forced lubrication. This engine, as well as all the auxiliaries, was built by the Chantiers de St. Nazaire, and details of the engine will be found in the appended table. There are two turbines for going ahead, one high-pressure and one low-pressure, each driving a propeller. The turbines are located in separate watertight compartments.

The reciprocating engine alone is used for cruising up to 20 knots, but above that speed steam is exhausted into the turbines. The reciprocating engine is designed to develop 3,000 indicated horsepower at 350 revolutions per minute. The turbines have been designed to develop a total of 6,000 horsepower at 750 revolutions per minute when receiving steam at full boiler pressure.

There are two independent condensers, one for the reciprocating engine and one for the turbines located in the center of the turbine room. The cooling surface of the condensers is 1130 and 4360 square feet respectively.

TRIALS.

The figures for the comparative coal consumption of these boats, as obtained on the official trial trips, are of interest. The boats driven by reciprocating engines at from 10 to 25 knots' speed show a less consumption of coal than those driven by turbines. The *Chasseur,* the only boat propelled by

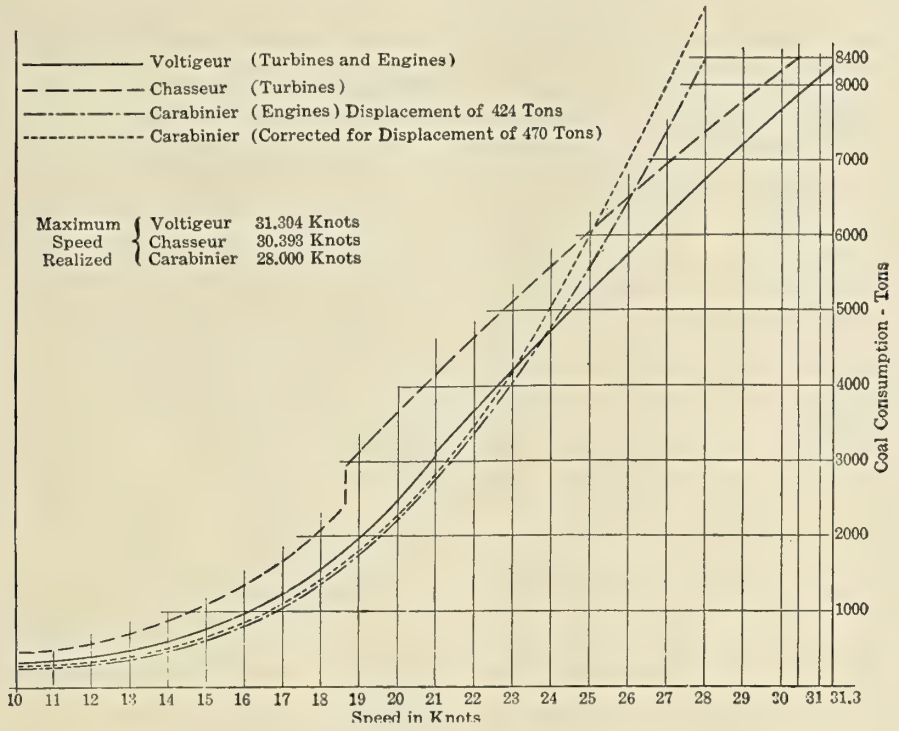


FIG. 8.—CURVES SHOWING COMPARATIVE COAL CONSUMPTION OF FRENCH DESTROYERS.

turbines alone, shows higher figures up to 25 knots, but above that point the turbines show to better advantage. The *Voltigeur* and *Tirailleur,* both fitted with combined reciprocating and turbine engines, show advantages for cruising speeds added to better figures for full power, if compared with boats of the reciprocating engine type. The *Voltigeur* gives the best results of both types. At slow speed her fuel consumption was nearly equal that of boats with reciprocating engines, and, therefore, better than that of boats driven by turbines alone. At full speed the consumption is nearly equal to that of the *Chasseur,* and even the *Voltigeur's* speed is .9 knot above that of the boat equipped with Parsons turbines. At cruising speed the *Chasseur* requires 81 tons of coal to run 1,170 miles, as against 52.87 tons required by the *Voltigeur.* The other boats, built at the same time, require respectively: Tirailleur, 57 tons; *Carabinier,* 32.33 tons; Hussard, 46.13 tons; *Spahi,* 44 tons. The saving of 28 tons if comparing the *Voltigeur* and *Chasseur* is considerable, and is accomplished by running the reciprocating engine exhausting to the turbines at low speed. At full power the advantage is caused by the economy of steam in the multi-stage expansion of the Rateau-Chantiers de Bretagne marine turbine. It is better than is readily understood at first sight, because the thrust of the propeller of the reciprocating engine is disadvantageous at high speed.

In short, it may be said that the *Voltigeur* gave the best speed coupled with the most economical fuel consumption. Several other features may also be taken into account. The hull of this destroyer has been especially designed by the well known naval architect Mons. Laubeuf, and the propellers are so placed that even in heavy weather they do not easily race. In fact, the boat is an exceptionally good sea boat and has weathered some severe storms. A good idea of the construction of the stern can be obtained from Fig. 2. The good results obtained with the *Voltigeur* are all the more remarkable when it is remembered that her hull is the first of this type, and that she is the first French naval vessel fitted with a combination of reciprocating engines and turbines, and also that many of her auxiliaries are used for the first time in France. After achieving such good results with this boat, the

TABLE I.

	Chasseur.	Voltigeur.	Tirailleur.	Carabinier.
Length over all	222′	215′ 3″	....	211′ 4″
Length B. P.	210′ 8″	....	206′ 11″	210′ 8″
Breadth, extreme	22′ 2″	22′ 10″	22′ 6″	21′
Depth	13′ 9″	14′ 4″	....	14′ 9″
Draft, astern	9′ 3″	9′ 10″	9′ 6″	9′ 4″
Displacement, tons	447	470	414	416
Boilers, type	Normand.	Normand.	Du Temple.	Du Temple.
Grate surface, square feet	232	232	230	230
Heating surface, square feet	11,100	11,100	9,900	9,900
Steam pressure, pounds per square inch	228	228	257	257
Air pressure in hold		2½ to 3 inches of water.		
Bunker capacity, tons	80	90	80	3,900 cu.ft.
Engines, type	....	3-cyl. triple.	3-cyl. triple.	4-cyl. triple.
Diameter cylinders, inches	....	17–25–38	20–29–41	20–31–34–34
Stroke, inches	....	20	23	20
R. P. M. maximum	....	380	350	333
I. H. P.	....	2,700	3,500	7,500 (5 hrs.) 8,200 (1 hr.)
Turbines, type	Parsons.	Rateau—Ch.d.B.	Breguet.	....
Ahead turbines	4	2	2	....
Astern turbines	2	2	2	....
Cruising turbines	1	....	....	....
R. P. M.	940	850	....	....
Total horsepower	7,800	6,250	5,800	....
Cons. surface, square feet	(?)	37,800	(?)	(?)
Vacuum, inches	29	29	29	29
Propellers	3	3	3	2
Diameter	4′ 7″	(?)	(?)	(?)
Armament	Six 2.56-inch quick firing guns, 2,300 shells; three 18-inch torpedo tubes, six torpedoes.			

TABLE II.—OFFICIAL TRIALS.

8-Hour Trial at 14 Knots Speed.

	Chasseur.	Voltigeur.	Tirailleur.	Carabinier.
Displacement on trial	470	468	450	428
Mean speed, knots	13.872	14.09	14.08	14.02
Coal per hour, pounds	2,128	1,402	1,533	1,003
Coal per square foot grate surface per hour, pounds	18.2	12	12.5	8.73
Coal per mile at 14 knots, pounds	153.4	99.6	109.5	71.3
Coal required to cover 1,170 miles at 14 knots, tons	79.7	52	56.1	37.3

5-Hour Trial at 24 Knots Speed.

Mean speed	25.58	24.74	24.42	24
Coal per hour, tons	6.34	5.03	5.58	4.73
Coal per square foot grate surface per hour, pounds	61.1	47.6	53.7	45.8
Coal per mile run, pounds	555.7	456.4	512.2	441
Coal per mile at 24 knots, pounds	511.6	436.6	435.9	441

1-Hour Full Speed Trial.

Mean speed	30.393	31.304	28.85	27.7
Coal per hour, tons	8.35	8.15	8.43	8.26
Coal per square foot grate surface per hour, pounds	80.5	77.2	81.2	80.4
Coal per mile run, pounds	615.2	582.1	652.7	66.81
Coal per mile at 30 knots, pounds	604.2	568.9	.....	.....

builders received an order for two 750-ton destroyers for the French Admiralty of 14,000 horsepower, 32 knots speed, and an order for four destroyers for the Argentine Navy of 900 tons displacement and from 32 to 33 knots' speed.

The hulls of these boats have been built with particular care. The keel is 18 inches deep for three-quarters of the length amidships, and a quarter inch thick. The stems are of forged steel and the outboard propeller shaft bearings of cast steel. The hulls are divided into ten watertight compartments. The auxiliary machinery consists of an electric generator of 100 amperes, 80 volts; steam steering gear and hand steering gear, a steam pump with a capacity of 2,500 gallons per hour, eight ejectors with a capacity of 100-tons per hour, one 200-ton and one 1,200-ton turbine pump and an air compressor for the torpedoes. Since more powerful boats have now been ordered by the French Admiralty, there will soon be an opportunity for an interesting comparison between them and those described in this article.

THE INSTITUTION OF NAVAL ARCHITECTS *

The Institution of Naval Architects is to be heartily congratulated upon the completion of its first half century of useful service. Beginning with a membership of some 300 at the end of the year 1860, it has now reached, through a period of uniform success, a total of 1,750. It has become the central institute of a great industry scattered around the coast of the United Kingdom. On its Council are representatives of practically all districts where shipbuilding and engineering are practiced, while among its associates are to be found many shipowners and representatives of the large shipping institutions, as well as naval officers and scientific men interested in the theory of shipbuilding. It seems an appropriate occasion, when the attention of every similar society in the world is directed toward the British institution by reason of its fiftieth anniversary to give a short account of its life work and aims.

On Jan. 16, 1860, at the hall of the Society for the Encouragement of Arts, Manufactures and Commerce, Adelphi, London, at a meeting of some eighteen gentlemen, the following resolution was moved by Mr. Oliver Lang, and seconded by Mr. John White: "That we who are here present do now constitute ourselves an Institution of Naval Architects, for the purpose of advancing the science and the art of naval architecture." The names of these gentlemen who thus became the founders of the society were as follows: Nathaniel Barnaby, F. Kynaston Barnes, H. Chatfield, J. B. Chessill Crossland, J. Grantham, Oliver Lang, J. MacGregor, J. Martin, Alexander Moore, John Penn, E. J. Reed, J. H. Ritchie, W. B. Robinson, J. Scott Russell, P. Thornton, G. Turner, J. White and the Rev. Joseph Woolley. Of these only Sir Nathaniel Barnaby is alive now.

For many years the need of such an institution had been felt by those interested in the welfare of British shipbuilding. Although the greatest maritime nation upon the face of the earth, Great Britain had never up to that time been able to concentrate the knowledge which was individually possessed by her citizens into one mass, nor was there any public body to which reference could be made in the investigation of professional questions. In other sciences, such as geology and geography, the experiment of establishing an institution had been tried, and always with success, and the more recent example of the civil engineers made the success of this new undertaking seem possible, although the failure of some previous attempts weakened the confidence of many.

The period was a remarkable one in many ways. Owing to the shortsighted policy of the government there were but few trained naval architects in the country. A short while before a good deal of carrying trade had been wrested from English ships by the American clippers, owing to their handiness and speed, and British builders had been forced to recognize their superiority, and copy this class of ship to regain the trade. More recently the schooner *America* had visited England and given another hard lesson. The introduction of the power of steam had altogether altered the principles of naval arctitecture. All civilized countries were starting fair in the race of competition, and it was necessary that England should win. This was felt everywhere, with the natural result that the Royal navy was a subject of much anxiety to the public.

The beneficial influence which an institution of naval architects would exert on the most valued and cherished interest of the country could not be gainsaid, and several gentlemen began independently to consider it. At the end of 1859 Mr. John Scott Russell, who was well acquainted with the organization of the Society of Arts and the Institution of Civil Engineers, called together Mr. (now Sir Nathaniel) Barnaby, Mr. Samuda, Mr. Reed and Dr. Woolley to discuss the matter. In order to accomplish their task it was necessary to have an efficient and tactful secretary, and no better choice could have been made than Mr.—afterwards Sir Edward—Reed, who filled this position for the next three years.

Following the meeting in January, to which reference has already been made, came the inaugural meetings of the institute, which took place in the first week of March, 1860, in the hall of the Society of Arts, where, owing to the continued kindness of the society, the meetings are still held.

In view of the national interests likely to be advanced by the institution, and contrary to the general practice of technical societies, a non-professional president was chosen, and His Grace the Duke of Northumberland was asked to honor the institute by becoming its president, but owing to imperfect health he was debarred from undertaking the duties, and the Right Hon. Sir John Somerset Pakington, G. C. B., D. C. L., etc., consented to take the office. Much of the success of the institution from its inception was due to the steady adherence and unhesitating support of this its first president, who remained in office for twenty years. Indeed, the institution has been most fortunate in its presidents, among those who have presided over its deliberations being such notable men as Lord Brassey, the Earl of Glasgow and Earl Cawdor, who has held the office with distinction for the last two years.

These first meetings, on which so much rested, were most successful, and the beneficial influence of them was seen almost immediately in modifications of the Board of Custom's rule for granting tonnage allowance for propelling power and by Lloyd's modifying the application of their tables of scantlings. These points were raised and discussed during the meetings.

At first the institute consisted of only members who were professional naval architects or shipbuilders and associates; but after a few years, owing to the growing importance of engineering, marine engineers were also made eligible for membership, and still another class, termed associate members, was formed in 1899.

From the beginning it was laid down that the scope of the institution must of necessity be wide enough to embrace the consideration of all that is part of or belongs specially to a ship. In its records the objects of the society are given under three headings:

First, the bringing together of those results of experience which so many shipbuilders, naval officers and others acquire independently of each other, and which, though comparatively

* Editor's Note:—The year 1910 marks the fiftieth anniversary of the founding of the Institution of Naval Architects. It was planned to celebrate this anniversary by holding in July an International Congress of Naval Architecture and Marine Engineering, but, on account of the death of His Majesty, King Edward VII., the jubilee meetings have been postponed and will be held next year.

valueless when unconnected, tend much to improve our navies when brought together.

Second, the carrying out of experimental inquiries of too great magnitude for private persons to undertake individually.

Third, the examination of new inventions and the investigation of those professional questions which without such an establishment would be left undecided for many years.

That the institution has carried out this programme, so far as it was humanly possible, none who studies its printed transactions can doubt. Among the early works of the society was the drawing up of a scheme for the promotion of a school of naval architecture. This was the result of a paper read before the institute by Mr. J. Scott Russell in 1863, on the education of naval architects in England and France, drawing attention to the total absence of any provision for training the rising architect in this country. Two schools of naval architecture had previously been in existence, but these had both been abolished, the first in 1833, the second in 1853, by Sir James Graham.

This paper roused considerable interest in the subject, and as a result a committee, consisting of various members of the institute, set to work and approached the Admiralty on the matter. Their proposals were met in a very liberal spirit, and in November, 1864, a school of naval architecture was started at South Kensington, with Dr. Woolley as superintendent and Mr. Merrifield principal, on the lines worked out by the institution. This school was transferred later on to the Royal Naval College, Greenwich, where it has flourished to this day. Students from every maritime country in the world have been trained in it, and almost every present member of the Royal Corps of Naval Constructors received his training here. If no other object had been attained by the institution than the establishment of this school, by this alone its existence has been justified.

In more recent times the society has displayed its concern and interest in the training of young naval architects by its successful effort to revise the syllabus set by the Board of Education in naval architecture, by the institution in 1904 of a student class of members, giving to younger men most of the privileges of full membership. Also, owing to the generosity of several members, it is now able to award a valuable scholarship every year.

Another and important work of the institute in its early years, and one of which it may be justly proud, was its long-sustained effort to secure better provision against the loss of passenger and other vessels at sea. It was in 1866 that a resolution was passed calling together a meeting of the Council for the purpose of formulating recommendations for this. At the time there was grave suspicion as to the condition in which many merchant vessels went to sea; and the succession of losses, and in particular the loss of the *London* and *Amalia,* during the previous year showed the imperative necessity of some action being taken. The Council met on many occasions, and presented a report in 1867. In this report reference was made not only to the load-waterline and minimum freeboard question, but to equipment, sub-division, etc.

The Board of Trade and Admiralty were approached, with a view to a royal commission being held, but without success. The institution, however, did not allow the matter to drop, and further representations were made on several occasions during the next few years; but it was not till 1873 that a royal commission was issued. For this we are largely indebted to the energy and ability of Mr. Plimsoll, member for Derby, whose statements brought upon him several actions for defamation. The institution was represented on this commission in the person of Mr. Merrifield. The final report of the commission, so far as it directly concerned naval architure, was of a negative character, and it was not till 1883, when the Board of Trade appointed a committee, on which the institute was represented by Dr. Elgar, that definite rules for freeboard were laid down, and not till 1890 was the assignment of a maximum load line , as determined by these tables, made compulsory by act of Parliament.

It would not be possible in the space of this article to examine in any detail the work of the institution in every direction. No important movement or change, whether in theory or practice of shipbuilding or mercantile legislation, has taken place without very full discussion at its meetings, and not a few of these movements have been brought about by the initiative of the society itself. Two examples of this during the last decade may be given.

It was the direct outcome of representations made to the Admiralty by the Council that a committee (on which the institute was represented by Professor Biles) was formed in 1902 to inquire into the question of mercantile auxiliaries. Improved designs and speed were wanted, and some steps were necessary to prevent subsidized vessels being transferred to a foreign flag.

The building of an experimental tank at Teddington, for the purpose of testing ship models and for research work, is the latest and one of the best examples of the influence of the institution. It was at Glasgow, in 1901, that a resolution was passed to consider the possibility of such a tank. Italy, Germany, Russia, Holland and the United States all had adopted Mr. Froude's method of investigation, and it was most desirable that it should be more widely applied in the country in which it originated. The question was raised by the Council on several occasions. The proposal had behind it all the notable men in naval architecture, and in particular, Sir William White, through whose persistent efforts the idea has always been kept before the country. It was owing to the munificence of Mr. A. F. Yarrow, a vice-president of the institution, that it became possible, in 1908, to proceed with the building of such a tank, the major part of the maintenance of which is assured for a considerable period by a number of the large shipbuilding firms and shipowners of the country.

To see that the institution is succeeding in carrying out its aims as regards the gathering together of the results of experience, and promoting the investigation of professional questions, one needs only to turn to the volumes of the *Proceedings.* Here are to be found the classic researches of W. and R. E. Froude, W. J. Rankine and W. Fairbairn, and valuable contributions by Scott Russell, F. K. Barnes, Sir Nathaniel Barnaby, Sir William White, Sir Philip Watts, Professor Biles and Benjamin Martell. They contain a complete record of the development of ship construction, propulsion and navigation, and of all the principal achievements in these directions, and their wealth of data makes them invaluable to the naval architect.

Originating in a gift by the late Samuel Read (a former master shipwright of Sheerness), the institute has gathered together a collection of books, which constitutes a most valuable library of reference on any point in connection with naval architecture and the allied trades.

The institution exercises a considerable influence in all mercantile affairs by means of its representatives on various public bodies, such as the advisory committee to the Board of Trade, the technical sub-committee of *Lloyd's Register,* the engineering standards committee and the National Physical Laboratory. The society is also represented on the Courts of Liverpool, Sheffield and Bristol Universities, and on the governing body of the Imperial College of Science and Technology at South Kensington.

From an international standpoint the institution has a most beneficial influence. It is essentially cosmopolitan in its composition, numbering in its ranks distinguished men from every maritime country, to whom are due some valuable contributions to its *Transactions.* The various international meetings

of such societies as this, which have been held in recent years at London, Paris, Bordeaux, Berlin, etc., serve largely to promote the mutual appreciation of the allied interest of all nations in continued progress, and a more friendly feeling than would otherwise be possible.

The desirability of placing the institution upon a more permanent footing, and the universal recognition of its valuable services to the country in the past, have led the Council and members to apply for incorporation under a Royal Charter, and we hope that at the meetings in July the Council will be able to speak of the success of their petition to His Majesty the King.

STEEL SCREW COLLIERS, COASTWISE AND TRANSPORTATION.

Two steel single-screw colliers were recently completed by the New York Shipbuilding Company, Camden, N. J., for the Coastwise Transportation Company, Boston, Mass. The vessels are intended for the coastwise coal trade between Baltimore and Boston. Both are of the following dimensions:

Length between perpendiculars.....	360 feet.
Beam molded	49 feet.
Depth molded to upper deck.....	30 feet.
Load draft	22 feet 6 inches.
Deadweight at this draft.....	6,400 tons.
Gross tonnage	4,015
Speed, loaded, at sea.....	11 knots.

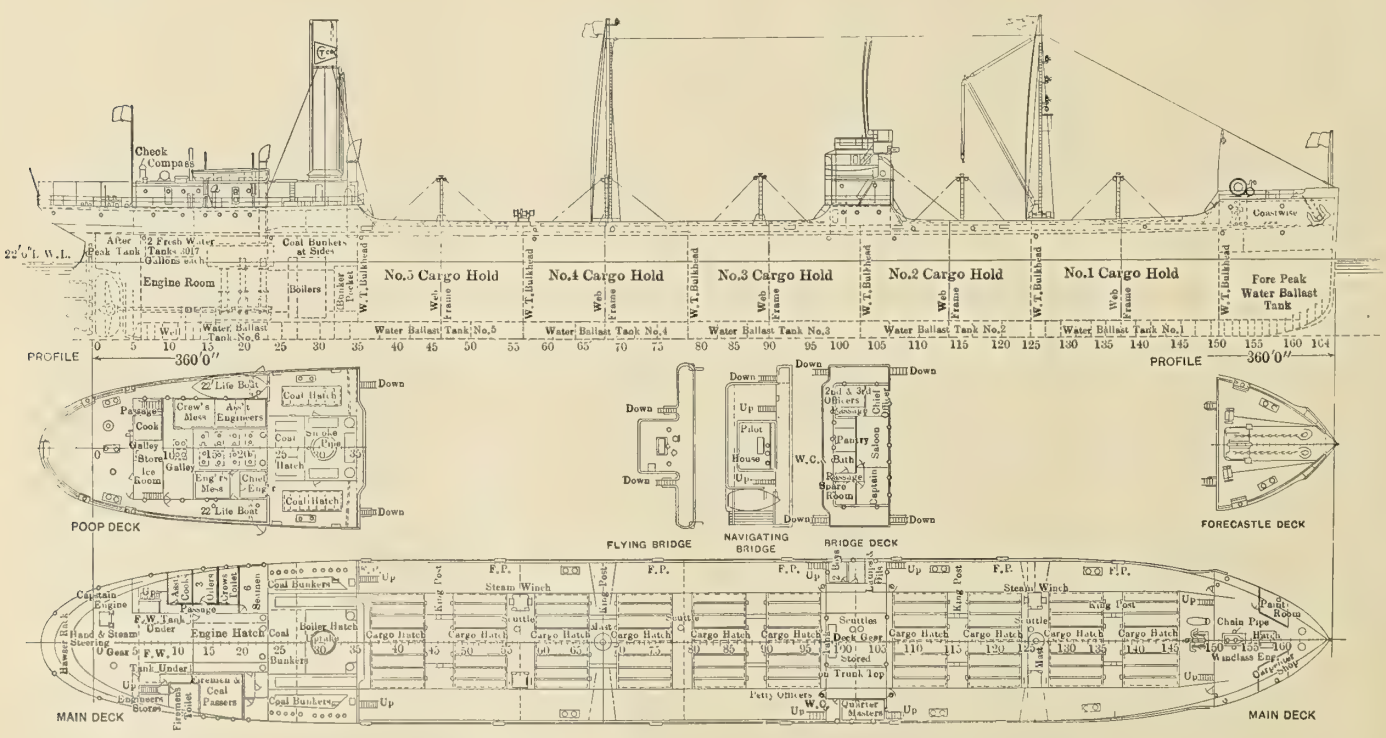
The vessels are of steel, built in accordance with the rules of the American Bureau of Shipping, single deck, with poop 76 feet, bridge 17 feet, and top gallant forecastle 34 feet long, seven steel watertight bulkheads, straight stem and semi-elliptical stern, with two pole masts. The five cargo spaces are clear of hold beams and pillars, the deck being supported by deep arched beams and web frames, midway between the bulkheads, with a deep girder, carried all fore and aft, forming a trunk 24 inches above the upper deck. Ten cargo hatches, 15 feet 2 inches long by 27 feet 6 inches wide, are arranged, closely spaced on top of the trunk to facilitate the rapid loading and discharging of the cargo. The hatch covers are steel, hinged in two pieces, watertight, and provided with special lifting gear and posts for supporting them when open. Two steam winches from which leads are taken for operating the hatch covers are placed on top of the trunk at each end of the vessel.

Accommodations, including the captain's saloon, spare stateroom, officers' quarters, etc., are provided in a large steel deckhouse on the bridge deck, with a pilothouse on top of the bridge house. Quartermasters and boys' quarters and toilet and lamp rooms are arranged at the sides in the bridge erection. The engineers are berthed in a deckhouse on the poop deck alongside the engine casing; the galley, messes, ice-room and galley stores being arranged abaft the same. Entrance to accommodations for the crew and firemen in the poop are provided in the after deckhouse, and the seamen, firemen, oilers, assistant cooks, toilets, etc., are located in the poop alongside the engine casing.

There is a steam windlass forward, the engine being located on the upper deck in the forecastle; the wild-cats and warping drums are on the forecastle immediately above. A capstan is also provided on the poop deck with its engine on the upper deck below. Steam steering gear is fitted on the upper deck in the poop abaft the engine casing, with connection to the pilot house. Auxiliary hand steering gear, with right and left-hand screw, is attached directly to the crosshead on the rudder stock. Two metallic lifeboats are provided and fitted under Mallory davits on the poop deckhouse, a wooden working boat being also provided on the bridge deck. Vessels are well provided with all the necessary bitts, cleats, etc., for mooring purposes, and a special towing bitt and chock is fitted aft.

An extra deep double bottom is fitted for the carriage of water ballast, with feed water under the boilers. The fore and after peaks are arranged for water ballast. Coal bunkers are arranged beside the boilers and in the 'tween decks alongside the boiler casing, with pockets to the fire-room.

The propelling machinery is placed aft, and consists of two



GENERAL ARRANGEMENT OF NEW COLLIERS BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

single-ended Scotch boilers, 17 feet diameter by 11 feet 4 inches long, with a working pressure of 175 pounds; triple-expansion engines of 1,700 indicated horsepower, with cylinders 24¼, 38½ and 64 inches diameter by 45 inches stroke, with a surface condenser attached. The propeller is 16 feet diameter.

The trial trips were run on the Delaware River course at Deep Water Point in fully ballasted condition, during which a mean speed of 13 knots was obtained, with somewhat more than the normal horsepower mentioned above. In loaded condition the vessels have maintained an average speed between Baltimore and Boston of slightly in excess of 11 knots, carrying a full coal cargo.

captain and officers is on the promenade deck above, which etxends the whole length of the bridge; the engineers and other officers' accommodation is arranged in steel houses under the bridge deck at the after end. The vessel has steel decks sheathed with wood on the poop, bridge, forecastle and promenade decks, and the whole of the passenger accommodation and public rooms are bright and cheerful, being lighted by large sidelights, and are specially ventilated in view of the tropical climate in which the vessel will be engaged.

Under the second class accommodation aft, provision is made for large icehouses, mail rooms, specie rooms, paint rooms, lamp rooms and general store rooms, and spacious accommodation for the seamen, firemen and petty officers is

NEW SINGLE-SCREW 4,000-TON COLLIER FOR THE COASTWISE TRANSPORTATION COMPANY.

TRIAL TRIP OF S. S. TAMELE.

On Saturday, April 30, 1910, the new steamer *Tamele* proceeded on her official trial trip after adjusting compasses in Hartlepool Bay. The vessel has been built by Messrs. Irvine's Shipbuilding & Dry Docks Co., Ltd., Middleton Shipyard, Hartlepool, and is the sixth vessel built by them for Messrs. Elder, Dempster & Co., Liverpool, and one of three passenger and cargo vessels under construction at the Middleton Shipyard for the same owners.

The *Tamele* has very fine lines, and has been specially designed with main, upper and shelter decks. The vessel is otherwise strengthened to suit the owners' West African trade. The dimensions are: Length, 375 feet; beam extreme, 50 feet; depth molded, 25 feet 3 inches to upper deck, with all the 'tween decks and houses 8 feet in height. She is classed 100 A1 at Lloyds, and has cellular double bottom all fore and aft, with fore and after peaks for water ballast. The vessel is divided into seven watertight compartments by six transverse bulkheads, and every attention has been paid to all appliances for the rapid loading and discharging of cargo, the ship having nine powerful steam winches of the builders' own design, and ten derricks capable of lifting 5 tons each; provision is made on each mast for a special derrick dealing with 30 ton loads, while the whole of the mast arrangement is strengthened to lift 40 tons.

Accommodations for 30 first class passengers in two-berth stateroms is arranged under the bridge, with ladies' cabins, lavatories, baths, etc., and second class passengers at the after end of the poop. The dining room is on top of the bridge, and the smoking room and accommodation for the arranged under the forecastle, with separate mess rooms and wash places for the crew and firemen.

The vessel is fitted with the usual complement of lifeboats, together with six surf boats of special design for carrying palm oil through the surf. A complete installation of electric light is fitted by Messrs. Campbell & Isherwood, Liverpool, including signal lamps, binnacle lamps, cargo clusters at each hatch, as well as oil lamps for emergency purposes. Steam steering gear is fitted amidships and a quick warping steam windlass forward, steam being supplied to all deck machinery from either of the main boilers.

The triple expansion engines, by Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool, are of special interest, because of the installation of the "Contraflo" system of steam condensation and feed water temperature regulation. The sizes of the cylinders are as follows: H. P. 25 inches, I. P. 40 inches and L. P. 68 inches by 48-inch stroke, supplied with steam from three main boilers working at 180 pounds pressure. A leading feature of the design which will appeal to those responsible for the economical running and maintenance of a marine engine is that the ordinary simple air pump is retained, but by an ingenious method of temperature regulation its air-withdrawing capacity can be so adjusted to meet requirements and so dominate the air leakage into the condenser that the thermal efficiency of the system is at a maximum under all conditions of working, thereby very favorably influencing the consumption of coal.

This system was fitted some time ago on Messrs. Elder, Dempster & Co.'s steamship *Bassam*, also built by Messrs. Irvine's Shipbuilding & Dry Docks Co., Ltd., and after a voyage to the west coast of Africa the results obtained were so strikingly satisfactory that the system was applied to the

steamship *Tamele* and will also be fitted to the other two boats yet to be delivered.

It was found in the steamship *Bassam* that a vacuum of 27 inches could easily be carried in the tropics, with the obvious advantage that the speed of the ship was maintained, whereas with the ordinary type of marine condenser, tropical water produces a considerable fall in vacuum and as a consequence the speed suffers.

The new design of Cascade Oil Filter fitted in the engine room also proved very successful in separating the float oil from the feed water before passing to the boilers. This filter also acts as a feed water heater, and steam from the evaporator, drainage water from the coils and also from the I. P. casing is led into the filter, with the object of utilizing the heat in the steam, and in the drainage water for raising the feed water to the highest temperature consistent with the effective working of the feed pumps, the degree of temperature being very conveniently controlled by the feed temperature regulating valve fitted on the condenser.

The power developed on the trial was 2470 I. H. P. at 86 R. P. M., and the results obtained were in every way satisfactory, a mean speed of 12¼ knots being obtained on the Whitley mile. The extreme flexibility of the Contraflo system was well illustrated, as a vacuum of 29 inches was obtained with a 30.2 inch barometer, a result which is remarkable for engines of the reciprocating type.

NEW AMERICAN BATTLESHIPS.

The contracts for the first two American battleships of the *Dreadnought* type were signed Aug. 6, 1907 These contracts were awarded to the Fore River Shipbuilding Company, of Quincy, Mass., for the construction of the *North Dakota,* and to the Newport News Shipbuilding & Dry Dock Company, of Newport News, Va., for the *Delaware*. The contract price of the former ship was $4,377,000 (£891,000), and of the latter, $3,987,000 (£820,000), which does not include armor and armor bolts (exclusive of protective deck), ordnance and ordnance outfit, and certain articles supplied by the government. The contract time for the completion of the *North Dakota* was thirty-four and one-half months, and for the *Delaware* thirty-six months. The fire rooms and boilers are fitted for both coal and oil fuel, and the closed fire room system is used. The two foregoing ships are now completed and ready to go into commission.

The *Delaware* was standardized over the measured mile course off Rockland, Me., Oct. 22 and 23, 1909, and attained a maximum speed on the full-power trial of 21.56 knots on a total of 28,578 indicated horsepower for the main engines on 128.38 mean revolutions per minute, 1.888 pounds coal per indicated horsepower of main engines, and a water consumption of 13.38 pounds per indicated horsepower of main engines only.

The *North Dakota* was standardized on the same measured mile course Nov. 4, 1909, and attained a maximum speed on the four-hour full-power trial, with slightly increased displacement, 20,051 tons, of 21.64 knots on a total of 31,826 shaft horsepower, at mean revolutions of both turbines of 280.8 per minute, 1.71 pounds of coal per shaft horsepower of main turbines, and a water consumption of 13.18 pounds per shaft horsepower of main turbines only.

The next two ships, the *Florida* and *Utah,* now under construction, the former at the Brooklyn Navy Yard, New York, and the latter at the New York Shipbuilding Company, Camden, N. J., are about 70 percent completed. The contract for the *Utah* was signed Nov. 24, 1908, at a price of $3,946,000 (£815,000), the time of completion being thirty-two months, the contract calling for a speed of 20¾ knots for four hours. The *Utah* was launched Dec. 23, 1909, and the *Florida* May 12, 1910.

The contract for the construction of the *Arkansas* was awarded Sept. 25, 1909, to the New York Shipbuilding Company, at a price of $4,675,000 (£961,000), time of completion thirty-two months; the contract speed being 20½ knots for four hours.

The construction of the *Wyoming* was awarded the William Cramp & Sons Ship & Engine Building Company, of Philadelphia, Pa., Oct. 14, 1909, at a total cost of $4,450,000 (£915,000), to be completed within thirty-two months. The contract speed is the same as for the *Arkansas*, or 20½ knots for four hours.

The present naval appropriation bill includes, among other vessels, two battleships, designated No. 34 and No. 35. The plans for these ships are nearly completed and have, as far as completed, received the approval of the Secretary of the Navy. The machinery of these vessels will be steam turbines of either the Parsons or the Curtis type, and, if of the former, will have four shafts; if of the latter type, two shafts. They will have watertube boilers of an approved design, and the speed will be 21 knots. The principal feature of these two ships will rest in the main battery, which will consist of ten 14-inch 45-caliber guns. The displacement will be about 27,000 tons, and the horsepower about 32,000, and the cost of construction probably in the neighborhood of $11,000,000 (£2,260,000). Principal dimensions and data will be found in the table appended.

PRINCIPAL FEATURES OF THE LATEST AMERICAN BATTLESHIPS

Hull, machinery and armament	(1) Delaware.	Florida.	Wyoming.	No. 34.
	(2) North Dakota.	Utah.	Arkansas.	No. 35.
Builder's name and place	(1) N. P. N. Sh. B. & D. Co., Newport News, Va.	N. Y. Navy Yard, New York.	Wm. Cramp & Son, Philadelphia.	.....
	(2) Fore River Sh. B. Co., Quincy, Mass.	N. Y. Sh. B. Co., Camden, N. J.	N. Y. Sh. B. Co., Camden, N. J.	.....
Length over all	(1) 518′ 9″	.....	.....	.....
	(2) 518′ 11¼″	521′ 6″	554′ 0″ on load waterline.	.....
Beam, extreme		85′ 2½″	88′ 2¾″	93′ 2⅝″	.....
Draft (mean)		26′ 10¼″	28′ 6″	28′ 6″	.....
Displacement, normal tons		20,000	21,825	26,000	27,000
Coal supply, tons		2,500	2,500	2,500	.....
Oil supply, tons		400	400	400	.....
Main battery		45 caliber, 10—12-inch.	45 caliber, 10—12-inch.	50 caliber, 12—12-inch.	45 caliber, 10—14-inch.
Secondary battery		14—5-inch.	16—5-inch.	21—5-inch.	.....
Belt armor		12″ to 8″	12″ to 8″	11″ to 9″	.....
Speed (contract), knots		21	20.75	20.5	21
Main propelling engines	(1) 4-cyl. triple expansion.	Parsons.	Parsons.	.....
	(2) 144″ Curtis turbines.	Turbines.	Turbines.	.....
Number of shafts		Two.	Four.	Four.	.....
Revolutions per minute	(1)	125	330	330	.....
	(2)	245	.....	.....	.....
I.H.P. or S.H.P. (designed)		25,000	28,000	28,000	32,000
Steam pressure at engine (gage)		265 lbs.	175 lbs.	175 lbs.	.....
Working pressure at boilers (gage)		295 lbs.	200 lbs.	210 lbs.	.....
Diameter of propellers	(1)	19′ 9″	9′ 2″	9′ 2″	.....
	(2)	13′ 0″	.....	.....	.....
Condensing surface in square feet	(1)	23,576	30,500	Alberger.	.....
	(2)	29,366	.....	28,000, Weir.	.....
Type of boilers		B. & W.	B. & W.	B. & W.	.....
Number boilers		14	12	12	.....
Number firerooms		1 single, 3 double.	3 double.	3 double.	.....
Length firerooms, total		128′ 0″	102′ 0″	102′ 0″	.....
Length engine room, total		44′ 0″	60′ 0″	60′ 0″	.....
Superheat		50 degrees F.	None.	None.	.....
Grate surface, total, square feet		1,439	1,428	1,428	.....
Heating surface, total, square feet		61,943	64,234	64,234	.....
Length of grate in feet		7	7	7	.....

In a paper presented to the American Society for Testing Materials, the following simple test to ascertain the value of lubricating oils under service conditions was described: The test consists of heating the oils to a temperature of 450 degrees F., at which temperature oils of an inferior nature show a decided darkening of color, while good oils appear to undergo very little change in color.

PASSENGER AND FREIGHT STEAMSHIPS CITY OF MONTGOMERY AND CITY OF ST. LOUIS.

The month of June witnessed the entrance into the New York-Savannah service of the Ocean Steamship Company, popularly known as the "Savannah Line," of the two latest additions to their fleet, which are also the most recent of the many passenger and freight steamships sailing from New York in the coastwise service. The vessels in question are the *City of Montgomery* and the *City of St. Louis*, the former named in honor of the capitol of Alabama and the latter in honor of the metropolis of Missouri. In the naming of these vessels the Ocean Steamship Company has continued the policy of naming their vessels after Southern cities. Other cities which have been so honored in the past are Savannah, Atlanta, Columbus, Memphis, Macon and Birmingham, and with the exception of the latter all are now represented in the company's fleet. The vessels of the line maintain a schedule of three sailings weekly between New York and Savannah and two sailings weekly between Boston and Savannah.

ONE OF THE NEW SAVANNAH LINE BOATS.

The *City of Montgomery* and *City of St. Louis* were designed and built by the Newport News Shipbuilding and Dry Dock Company at their works in Newport News, Va., and represent the most modern practice in coastwise vessels, combining as they do excellent passenger accommodations with convenient cargo handling arrangements.

Their principal dimensions are as follows:

Length over all	398 feet
Length on water line	380 feet 10 inches
Beam, molded	49 feet 6 inches
Depth, molded to hurricane deck	35 feet

The vessels are of the familiar hurricane deck type, universally used in the American coastwise trade. They have three complete decks and an orlop deck both forward and aft of the machinery space, the machinery being located amidships. There is also a promenade deck extending from the stern to within about 80 feet of the bow. The boats are carried one deck above the promenade deck and a flying bridge is at this same level. There are two steel pole masts schooner rigged, the relative location of the masts and stack presenting a very symmetrical appearance.

CONSTRUCTION OF HULL.

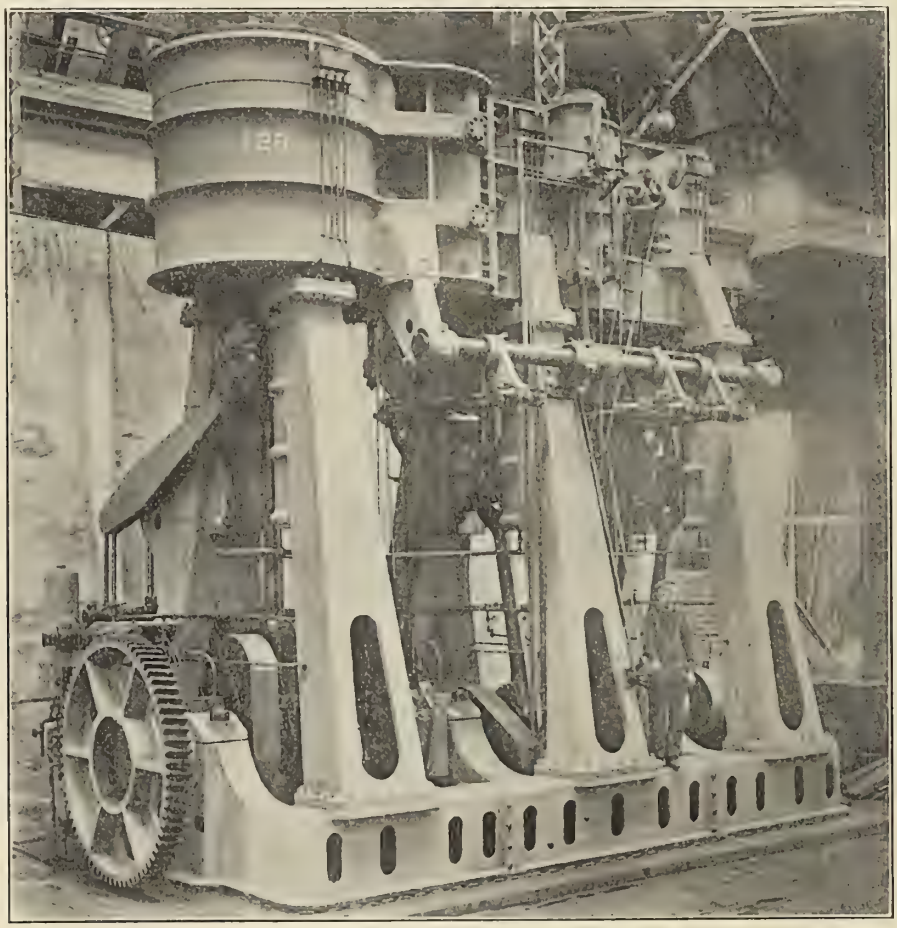
In one respect the construction of these vessels differs from the majority of passenger steamships in the coastwise trade. The latter are generally built without double bottom, or with only a partial double bottom in the machinery space, and only a few have complete double bottoms. In common with all the later Savannah Line vessels, the *City of Montgomery* and *City of St. Louis* have complete double bottoms extending from peak to peak. These are built on the cellular system with floor plates on alternate frames, excepting in the engine space, where floors are fitted on every frame. The frames in the double bottoms are cut at the margin, the latter being fitted normal to the frames. There are two side keelsons on each side of the vessels fitted intercostally between floors, and the vertical keel, which is 42 inches deep, is continuous from peak to peak, watertight throughout. At the margin the tank top plating overlaps the bilge brackets 18 inches, thus forming a very efficient tie.

Above the double bottom the main frames are channels extending from the margin angle to the main and hurricane decks alternately, excepting for a distance of 60 feet forward, where all frames extend to the hurricane deck. In the peaks the framing consists of angle and reverse bars. The four tiers of beams in the main hull are all channel sections fitted on alternate frames and supported by two rows of girders with wide spaced stanchions. This arrangement of stanchions intereferes less with the handling and stowage of cargo than

the usual small stanchions and has been adopted by the Newport News Shipbuilding and Dry Dock Company in most of the vessels built by them in recent years. The stanchions are cylindrical, built up of plates in the lower holds, and of wrought iron pipe in the upper. The girders under all decks consist of continuous double channels underneath the beams, with an intercostal plate which extends to the deck plating to which it is attached by angles. The orlop deck is fitted with stringers and tie plates and laid with a calked deck, over which 1 inch oak sheathing is fitted. The lower and main decks are complete steel decks without covering, excepting in way of quarters. An extra wide stringer is fitted on the hurricane deck so as to overlap the sills of the deck house; the rest of this deck is plated with light steel for protection against fire in the cargo space. Outside of the deck house this is entirely covered with a 3½-inch yellow pine calked deck and inside the house with a tongued and grooved joiner deck.

The hulls are divided into compartments by five watertight bulkheads, with one exception all extending to the main deck. There is also a non-watertight bulkhead between the engine and boiler rooms. Longitudinal bulkheads are fitted in the lower hold in way of the boilers, forming coal bunkers at the sides of the vessels. Engine and boiler casings of plate and angle construction extend from the lower deck to the top of the promenade deck house. The house on the hurricane deck is built of steel and stiffened at the forward end by webs.

Below the load water line the shell plating is joggled; above the water line the plating is fitted with inside and outside strakes. This method of plating is being largely used by the builders. In way of all cargo and coal ports reinforcing plates are fitted to maintain strength. A dished plate fender filled with pitch is fitted at the lower deck level and extends well forward and aft. The stem is rolled steel, rabbetted for the shell plating, and the stern frame is wrought iron made in two sections, with the scarfs so arranged as to facilitate repairs.



MAIN ENGINE OF THE CITY OF ST. LOUIS.

ACOMMODATIONS.

In the passenger accommodations the builders and owners collaborated to make the *City of Montgomery* and *City of St. Louis* truly representative of the highest type of passenger vessels, and expense was not spared to put them in the very first rank. The traveling public demand comfortable and even luxurious quarters, especially on vessels making a voyage of any length, and as the sailing schedule of these vessels calls for a voyage of about 63 hours' duration, the comfort of the passengers has been especially catered to. In the design of these vessels this object was kept constantly in mind, and the result is a vessel with large, roomy staterooms, an unusually large number of baths, an especially attractive dining room, handsomely finished lounges, writing and smoking rooms, and wide, extensive promenades.

Accommodations are provided for 130 first class, 36 second class and 57 steerage passengers. All first class accommodation are entirely above the hurricane deck, there being 38 staterooms and 2 special bedrooms in a steel deck house on the hurricane deck, and 21 staterooms and 4 special bedrooms in two wooden deck houses on the promenade deck. The second class quarters are located on the main deck aft and the steerage on the main deck forward.

At the forward end of the hurricane deck house is located the dining saloon with a seating capacity for 124 people. In this space the deck above is raised so as to give a deck height of 10 feet 6 inches, and the result is a saloon having an ap-

pearance of roominess such as is only obtained on the most modern trans-Atlantic liner. The general type of decoration here is French Renaissance, the finish being white with gold trimmings, above a low wainscoting of mahogany. Paneled ceiling and four Corinthian columns in the center enhance the beauty of the saloon. In the space between the promenade deck outside and the top of the saloon inside, transom lights of leaded glass are fitted which add materially to the appearance, and these, together with the large windows, which are fitted in pairs at the sides of the house, make a saloon particularly well lighted. The electric fixtures are bronze of very attractive design, and are so numerous, and so well located that the illumination at night is remarkably fine. A large, handsome sideboard of mahognay set in a recess at the after end forms a very attractive feature. The dining tables and chairs are mahogany, the latter upholstered in a red figured tapestry. A Royal Wilton carpet covers the entire saloon floor.

Aft of the dining saloon, to which it has convenient access, is the first class pantry, a large, roomy space exceedingly well lighted and ventilated by means of overhead skylights. The floor is laid with mosaic tiling and the outfit is of the most modern type, including steam table, urns, etc. Food is conveyed from the galley, which is on the main deck directly below the pantry, by means of a dumb waiter and a private stairway, all enclosed so that no objectionable odors from the galley can escape into the dining saloon. From the dining saloon inside passages on each side of the machinery casings lead to a social hall or lounge located aft of the engine hatch. Single rows of staterooms with access therefrom are fitted along these passages, two of the rooms on each side having a private bath and several of them being arranged with communicating doors for use as family rooms. Immediately aft of the social hall are two special bedrooms with private baths. These rooms are nicely paneled and are fitted with large

VIEW ON PROMENADE DECK.

brass beds. The balance of the space aft is devoted to staterooms, with toilets and baths at the extreme end. Other toilets are located between the boiler and engine hatches, with access from an athwartship passage. All baths and toilets have tiled floors. The fact that there are twelve bath rooms for the exclusive use of first class passengers indicates how complete the toilet arrangements are.

At the after end of the after house on the promenade deck and opening thereon is located a reading and writing room, access to which is obtained also from the hurricane deck by means of a mahogany stairway and from the upper social hall by a wide central passage between rows of staterooms. At the head of the stairway, in the end of the house, is a handsome leaded glass window, the design on the *City of St. Louis* portraying King Louis IX of France, in whose honor the metropolis of Missouri was named. His coat of arms is worked in a handsome panel directly underneath the window.

MAIN DINING SALOON.

On the *City of Montgomery* the window has an appropriate marine design with a similar panel underneath. Several handsome mahogany writing tables with attractive electric fixtures, also a large table for magazines, are located in the writing room.

Like the dining room, the style of decoration in the writing room, upper and lower social halls, and passages is French Renaissance, the finishing being ivory and white. Upholstery and carpets in the writing room and upper social hall are green; in the lower social hall and stateroom they are red. All upholstery in public spaces is figured plush, except in the smoking room, where Spanish leather is used.

The upper and lower social halls or lounges are large, comfortable spaces connected by a wide mahogany stairway, over which is fitted a large handsomely lighted dome skylight, of prismatic glass. A large mirror is fitted at the head of this stairway. Off the upper social hall at its forward end, on either side, is a special room with private bath. These rooms are handsoemly paneled with silk tapestry, one in green and the other in old rose. These colors are also used in the tile wainscoting in the private baths attached. The bedrooms have full size brass beds, a roomy wardrobe and full-length mirror, making them truly elegant rooms. The other two bedrooms with private baths on this deck are located aft of the upper social hall.

Another room to which special attention was paid is the smoking room, located on the promenade deck forward of the boiler hatch. This is an especially large room, handsomely finished in mahogany. The style of decoration is old English, with tapestry panels. The hand carved lion heads are particularly attractive. A large decorated dome, the full length of the room and almost its entire width, accentuates the appearance of roominess. Rubber top mahogany tables, comfortable chairs, leather upholstered seats, writing tables, comfortable settees and rubber tiled floor make this an ideal room for male travelers. Access to the smoking room is obtained by an enclosed stairway from the passage on the hurricane deck as well as from the promenade deck direct. There is also a toilet room off the smoking room.

All the regular first class staterooms have two mahogany

berths, the upper one arranged to fold up like a Pullman berth. There is also a wide full length upholstered seat in each room. The lavatories are porcelain, and all the toilet fixtures in the staterooms, as well as in the bath rooms and toilets, are nickel plated, including the mirror frames.

An important feature not to be overlooked is a completely equipped barber shop located amidships on the hurricane deck. The deck in this shop is covered with white rubber tiling and the outfit includes a lavatory with hot and cold water and shampoo attachment.

Accommodations for the 36 second class passengers are provided in 12 staterooms of 3 berths each loacted on the main deck aft. A good sized cabin well lighted by a skylight overhead is also provided for their use. Berths for 18 women and 39 men are provided in steerage quarters on the main deck forward, this space being entirely separated from all other quarters and having its own companionway. There is also a separate steerage pantry with steam table and urns. All berths for second class and steerage passengers are metal.

While the comfort of pasengers has been so well taken care of, that of the officers and crew has by no means been neglected, and among seafaring men these vessels will most assuredly have a reputation of being "a good berth." The captain's cabin in its finish and decoration is equaled by few and surpassed by none. It is handsomely paneled in quartered oak, with paneled ceiling, is well lighted by a decorated overhead skylight and has a desk and table specially designed to match the finish of the room. There is also a private bath for the captain. Quarters for the deck officers are located on the promenade deck just aft of the captain's cabin.

A stateroom and office for the chief engineer are located on the hurricane deck opposite the engine casing, and the purser's office and stateroom are on the opposite side, the office having a window opening into the lower social hall. All other engineers' and crew's quarters, excepting the waiters, are on the main deck amidships abreast the machinery casings. These quarters include an officers' mess room and separate shower baths for the deck and engineer officers. The waiters are quartered at the after end of the main deck.

The galley, bakery, dry stores and cold storage rooms are located on the main deck amidships and are equipped with all modern conveniences. Throughout the vessels, companion ladders are located in convenient places for access to and from all decks. In order to give an unobstructed promenade the life boats are located at the level of the top of the promenade deck houses, the top of these houses being carried to the sides of the vessel to form a boat and shade deck. Other parts of the promenade deck, are provided with canvas awnings.

CARGO ARRANGEMENT.

The cargo capacity of these vessels is quite large, being about 325,000 cubic feet, most of the space up to the hurricane deck being devoted to cargo. The cargo usually carried is general merchandise which is handled by trucks through cargo ports. At times, however, bulky articles are carried, and for the handling of these two booms with a lifting capacity of 10 tons each, are fitted on a table on the foremast for use over the forward hatch, which is the only cargo hatch in the hurricane deck. In the other decks there are four hatches, two forward and two aft, the latter arranged in pairs to straddle the shaft alley. At each of these hatches on the main deck there is located an 8 inch by 8 inch double drum steam winch and two swinging cargo cranes, by means of which cargo is handled. The loading and unloading in the after holds is done entirely through cargo ports of which there is one on each side of the vessels between the main and hurricane decks and one between the lower and main decks. There are also two cargo ports on each side forward between the main and hurricane decks and one between the lower and main decks. All cargo ports are fitted with watertight doors, those between the main and hurricane decks being hinged in two parts, and those between the lower and main decks being of the sliding type with small hinged doors fitted in them for use in operating.

The vessels are coaled through two hinged ports located on each side between the lower and main decks. Through these ports coal is taken direct into the upper bunkers, and the lower bunkers are filled through scuttles in the deck. The total capacity of the bunkers is 450 tons, evenly divided between the upper and lower bunkers, this capacity being sufficient for a round trip. As the vessels are coaled in New York for the round trip, the upper bunker space is available for cargo on the return trip, and this space is so arranged, water-tight doors being fitted in the bulkheads at the forward and after ends of the bunkers for access from the regular cargo space.

The space between the lower and main decks aft over the after peak is arranged for carrying combustible goods, a water-tight door in the bulkhead forming access to the space.

HULL AUXILIARIES.

A steam windlass is located on the main deck forward and a warping capstan driven by the windlass engine is located on the hurricane deck directly over. On the hurricane deck aft there is another steam warping capstan with the engine in the base of the capstan. Steam steering gear is fitted, the engine being located on the main deck off the engine room. Hand steering gear of the right and left hand screw type is also provided on the hurricane deck aft. All the deck machinery was supplied by the Hyde Windlass Company, Bath, Me.

The vessel is heated throughout by steam and lighted by electricity, the fixtures being exceedingly handsome. The electric plant consists of two 20 kilowatt 110-volt generating sets, located in the lower engine room. The running lights are combination oil and electric and a running light indicator is located in the pilot house. There is a complete call-bell system connected to all staterooms, etc., and also a complete system of interior communication consisting of engine, steering and docking telegraphs, the latter being located on the flying bridge and on the promenade deck aft. Wireless telegraphy is also fitted with a completely equipped station on the promenade deck adjoining the smoking room.

PROPELLING MACHINERY.

The propelling machinery consists of a triple expansion engine with cylinders 26 inches, 43 inches and 72 inches diameter respectively and a common stroke of 48 inches, four main boilers of the Scotch type and one Scotch donkey boiler. Piston valves are fitted to all cylinders, one on the H. P. and two each on the M. P. and L. P., all worked by Stephenson double bar link motion. The housings are fitted with crosshead guides, both front and back, and they as well as the bedplate are cast iron of box section. The crank shaft is built up in three interchangeable sections, the thrust bearing is of the horseshoe type, and the propeller is a sectional one, with cast iron hub and manganese bronze blades. Steam turning and steam reversing gear are fitted. The air pump and two bilge pumps are worked from the L. P. crosshead, but the condenser and all other auxiliaries are independent. The condenser is cylindrical, with cast iron shell, and the circulating pump is of the centrifugal type of the Newport News Shipbuilding and Dry Dock Co.'s standard make. All other pumps are horizontal duplex and comprise two feed, one donkey feed, hotwell, fire, sanitary, fresh water, and ballast pumps. There is also an auxiliary condenser with a combined auxiliary air and circulating pump for port use. A feed

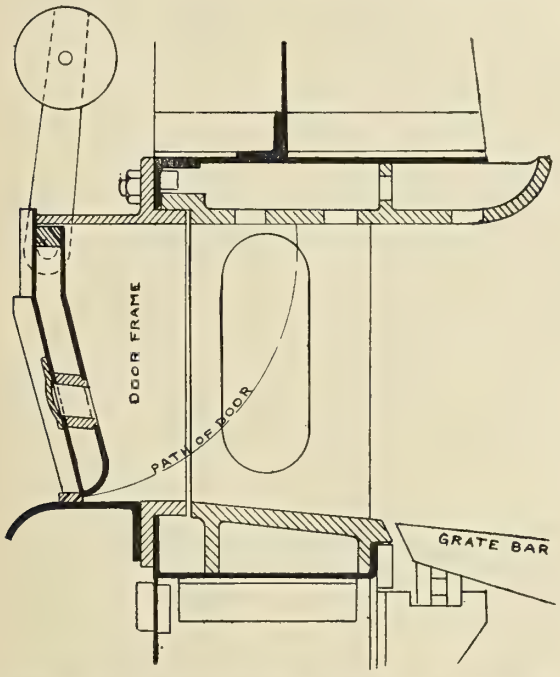
water heater is also fitted, it and all steam pumps being of the Blake type.

The four main boilers are arranged with a common athwartship fireroom and all are connected to one stack. They are 14 feet diameter by 11 feet 6 inches long, built for 180 pounds steam pressure and each has three 43-inch Morrison corrugated furnaces with separate combustion chambers. The total heating surface is 8160 square feet, and the grate surface 258 square feet. The donkey boiler is located on the main deck and is 10 feet diameter by 9 feet 6 inches long, with a working pressure of 90 pounds. It has two 35-inch Adamson furnaces and 177 3-inch tubes, giving a grate surface of 32 square feet and a heating surface of 1084 square feet.

The vesels were built throughout under special survey of the American Bureau of Shipping to class A1 for twenty years, the classification including the hull, machinery and electric plant.

Inswinging Furnace Doors.

A London engineer, W. A. Martin, patented the inswinging furnace door in 1874. It was applied extensively on the then commonly-used shell boiler, but gradually went out of use. Owing to its demonstrated merit in being automatic in closing it has again come into extensive use, especially on watertube boilers. The handiness and readiness with which it may be opened and closed as well as the protection it offers in case of the bursting of tubes in preventing the rush of steam from



SECTION THROUGH FURNACE MOUTH, SHOWING DETAILS OF DOOR.

reaching the boiler room by its closing automatically renders it a most valuable adjunct when fitted in large boiler installations having closed fire-rooms.

Referring to the figure, showing the door as attached to a Niclausse boiler, its simplicity is strikingly in evidence, and a change from the ordinary outwardly opening door to this type of door is easily made, should it be desired. It is ordinarily composed of a door frame having a bearing for the pivoted hinge, which is riveted to the upper edge of the door. The lintel and deadplate are fitted between the frame and the furnace. The pivots extend beyond each bearing sufficiently to attach the arms which carry the balance weight, the door frame extending outward far enough to allow the proper clearance between the front of the boiler and the balance weight.

The construction of the front wall of most watertube boilers is usually of such nature as to provide space enough for the door within said front wall to be at rest in a natural pocket, thereby being fully protected from the action of the fire or the intense heat within the furnace.

In order to render the door as sensitive as possible the balance weight can be adjusted into a position where only the slightest pressure back of it will start it moving, as would be the case in a sudden rush of steam from within. The slight vacuum formed in front of the door, should steam escape at high velocity, undoubtedly serves as an additional agent to promote its action.

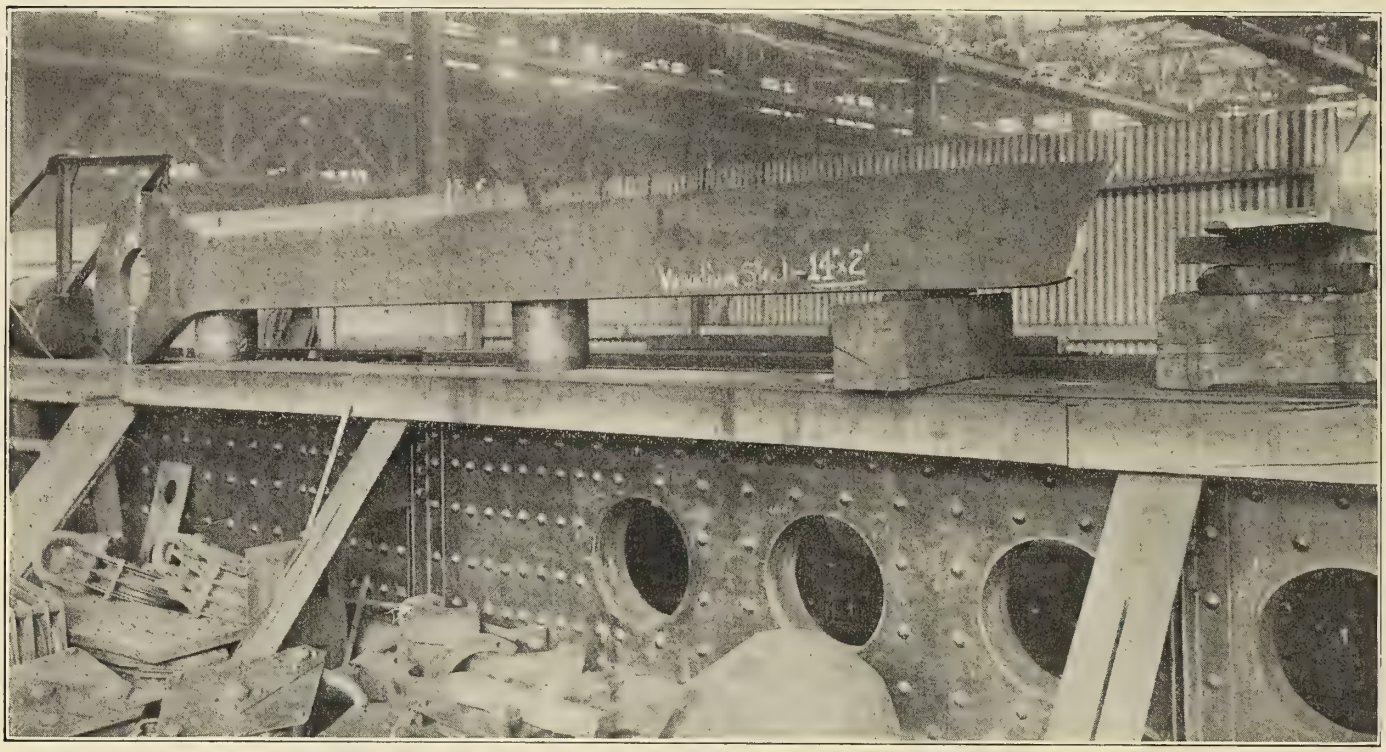
It has been found of such great value in several instances where fitted on boilers now in service on board United States naval vessels that all new boilers, in which coal is used for fuel, are being specified to have this type of furnace door, and the change is also incorporated in the older boilers as opportunity offers.

Whaling Vessel Sheathed with Leather.

An interesting log book has been brought to our office of the ship *Atlas,* 249 tons, which sailed under command of Captain James Townsend from New York, September 10, 1826, for the coast of Brazil on a whaling voyage. The log states that this ship was sheathed with leather, but unfortunately gives no statement as to how satisfactory leather sheathing proved. The only reference to it is under date of October 4. "Latter part (of day) hove aback to mend our leather."

According to the *Army and Navy Register* the two new revenue cutters authorized by Congress will be of the full spar-deck type, 200 feet long, 34 feet beam, with an extreme draft of 15 feet. The engines will be vertical, triple expansion, reciprocating, with a stroke of 36 inches, and will develop 1,800 indicated horsepower under natural draft and 2,000 indicated horsepower under forced draft on the closed stokehold system. Two Babcock & Wilcox watertube boilers will supply steam. Under ordinary good cruising conditions the speed is to be 14 knots for a period of eight hours; the maximum speed under the same conditions is to be 15 knots. The coal capacity is to be not less than 300 tons, and the radius of action about 4,500 nautical miles at economical speed. The fresh water capacity of each vessel will be 17,000 gallons, exclusive of fore and after-peak tanks.

The designs for four new Russian *Dreadnoughts,* now under construction, are being severely criticised. These vessels are said to be 590 feet long, 89 feet wide and 27 feet 3 inches deep, with a displacement of 23,000 tons. They are designed for a speed of 23 knots, the engines being of 42,000 horsepower. The principal criticisms are directed at the armor and armament. The former is considered altogether too light for modern battleships, while the latter involves features which have been severely condemned by other naval authorities. The main armament is to consist of twelve 12-inch guns, arranged in four turrets, three guns in each turret. The secondary battery is said to be so located that the guns cannot be served when the 12-inch guns are being fired. The vessels are also said to be deficient in boiler power. In order to keep the weight of hull and fittings as small as possible, it was decided to use high tensile steel, as it was thought that by so doing the scantlings could be materially reduced throughout. There are two objections to this, however. The first is that reducing scantlings destroys the stiffness of the structure, and the second is that Russian steel makers cannot produce sufficient high tensile steel of the proper quality.



VANADIUM STEELS

For Structural Work

This photograph represents a full sized eyebar of Vanadium Steel, 14 ins. wide, 2 ins. thick, 27 ft. long. It was tested to destruction at Ambridge, Pa., and gave a tensile strength of 99,890 lbs. per sq. in.; elastic limit, 80,840 lbs. per sq. in.; reduction of area at fracture 52.3%; elongation in 12 inches, 32.5%; elongation in 20 feet, 7.9%.

A number of similar bars were also tested and gave similar results.

We are confident that Vanadium Steel will solve the serious problems that every Bridge Designer is obliged to meet in order to satisfy modern requirements.

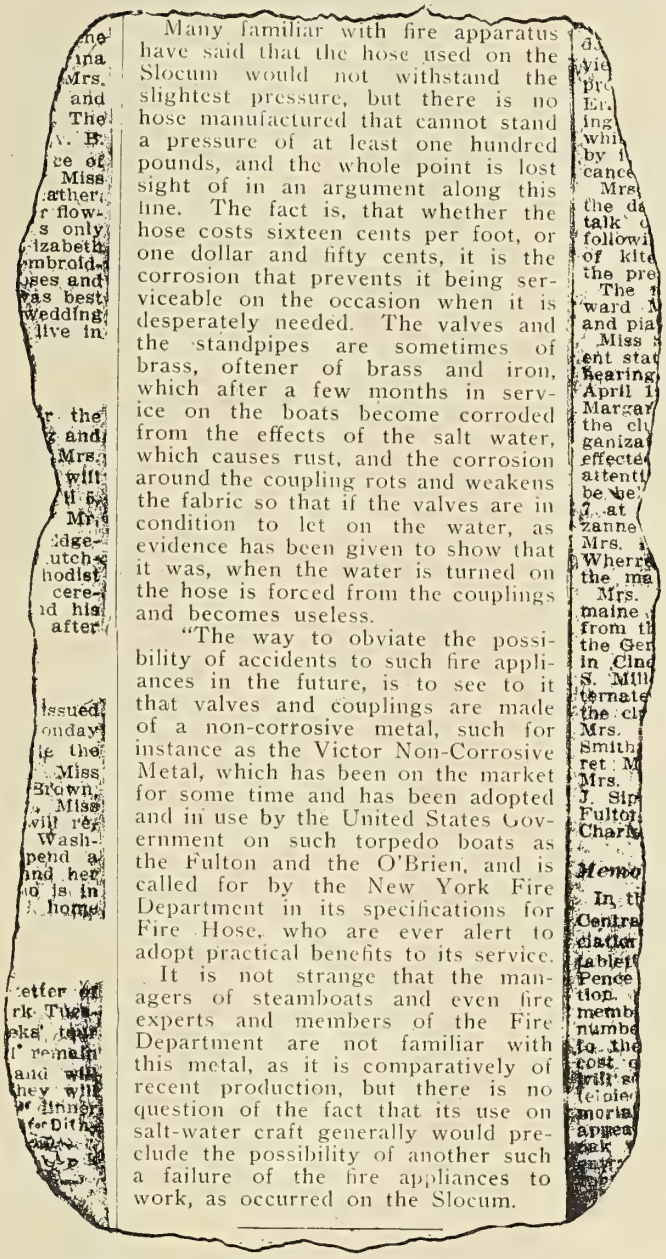
Vanadium Steel gives what no other type of steel has been able to give in static and dynamic qualities, at a price that permits its employment in the largest structures, and at every point where maximum results must be secured. Correspondence on this intensely interesting subject is invited.

AMERICAN VANADIUM CO.

318 Frick Building, Pittsburgh, Pa.

CORROSION ELIMINATED

Clipping New York published investigation of the by fire hundreds of



Many familiar with fire apparatus have said that the hose used on the Slocum would not withstand the slightest pressure, but there is no hose manufactured that cannot stand a pressure of at least one hundred pounds, and the whole point is lost sight of in an argument along this line. The fact is, that whether the hose costs sixteen cents per foot, or one dollar and fifty cents, it is the corrosion that prevents it being serviceable on the occasion when it is desperately needed. The valves and the standpipes are sometimes of brass, oftener of brass and iron, which after a few months in service on the boats become corroded from the effects of the salt water, which causes rust, and the corrosion around the coupling rots and weakens the fabric so that if the valves are in condition to let on the water, as evidence has been given to show that it was, when the water is turned on the hose is forced from the couplings and becomes useless.

"The way to obviate the possibility of accidents to such fire appliances in the future, is to see to it that valves and couplings are made of a non-corrosive metal, such for instance as the Victor Non-Corrosive Metal, which has been on the market for some time and has been adopted and in use by the United States Government on such torpedo boats as the Fulton and the O'Brien, and is called for by the New York Fire Department in its specifications for Fire Hose, who are ever alert to adopt practical benefits to its service.

It is not strange that the managers of steamboats and even fire experts and members of the Fire Department are not familiar with this metal, as it is comparatively of recent production, but there is no question of the fact that its use on salt-water craft generally would preclude the possibility of another such a failure of the fire appliances to work, as occurred on the Slocum.

from newspaper during of destruction General Slocum in which lives were lost

FIVE SATISFACTORY YEARS OF SEVERE MARINE SERVICE

VICTOR VANADIUM NON-CORROSIVE SILVER METAL CASTING TESTS

Test Number.	Mark on Specimen	Dimensions in Inches Diam.	Sectional Area Square Inch.	Elastic Limit.		Ultimate Strength.		Elongation in 2 Ins.		Area at Fracture.	Contraction of Area, %	Appearance of Fracture.	Elongation of Inch Sections.
				Total Pounds.	Lbs. per Sq. Inch.	Total Pounds.	Lbs. per Sq. Inch.	Inches.	%				
13,155	1 U S	1.00	.7854	28,200	35,910	51,200	65,190	.17	8.5	.96 diam.	7.8	Uniform Light Gray	.12,* .05 VictorSilverMetal
	1 U S	1.00	.7854	35,800	45,580	51,400	65,440	.14	7.0	.97 diam.	5.9	Uniform Light Gray	.09,* .05 VictorSilverMetal
	2 U S	1.00	.7854	28,500	36,290	52,500	66,840	.25	12.5	.94 diam.	11.6	Uniform Dark Gray	.10, .15* VictorSilverMetal
	2 U S	1.00	.7854	29,900	38,070	52,460	66,720	.19	9.5	.95 diam.	9.7	Uniform Dark Gray	.09, .10* VictorSilverMetal

(Signed) I. MACNUTT,
Major Ord. Dept. U. S. A.
Commanding.

VANADIUM METALS CO., Frick Bldg., Pittsburgh, Pa., U. S. A.

Foundry, EAST BRAINTREE, MASS.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Accidents Attributable to Design and Inexperience in Operation.

Excellent workmanship and good materials in the construction of marine engines are not alone sufficient for successful operation. Carelessness and faulty design, especially when followed by inexperience of the fundamental principles upon which operation of machinery should be conducted, are often the causes of serious accidents.

Therefore it may not seem altogether equitable to hold a contractor responsible for the working of machinery built on plans and specifications which are not his own, nor to hold the superintendent of construction responsible for defects that develop purely as the results of bad design or neglect in maintenance. Yet circumstances often place the blame of unfortunate accidents to machinery on the persons that are not to blame.

Some years ago a contract was awarded to build, on plans and specifications furnished by the owners, a certain type of

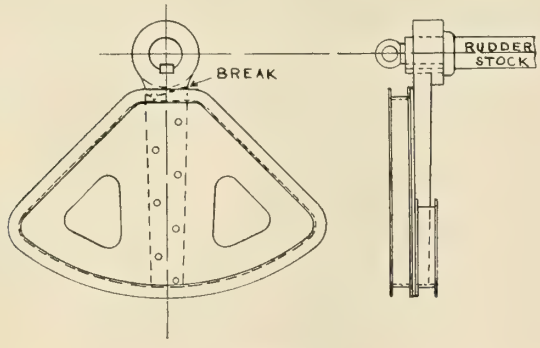


FIG. 1.

steamer equipped with, what was considered then and probably is now for that type of boat in the way of general design, a modern and up-to-date machinery installation, although the details were in many respects wanting. The machinery consisted of a triple-expansion engine with all necessary auxiliaries, two cylindrical boilers with corrugated furnaces and independent combustion chambers, a complete installation of electric light machinery besides independent machinery for wrecking and drainage service.

The engine cylinders were 16½ inches, 27 inches and 46 inches diameter by 35 inches stroke, with a piston speed giving about 110 revolutions per minute when working with 165 pounds steam pressure at the high-pressure cylinder. This cylinder had a piston valve with solid rings, the intermediate-pressure cylinder had a single-ported, unbalanced slide valve, which was also the case in the low-pressure cylinder, except that the slide valve here was double ported and was provided with a balance piston. The valve gear consisted of the Stephenson link motion, double bar and cast iron eccentrics, with straps of the same material without white metal linings. The main steam pipe connected direct from the boilers to the throttle without a separator. By-pass valves were fitted to both receivers, and besides the regular throttle and reversing gear efficient gear for oiling and water service was fitted complete throughout the engine. The main journal bearings had bottom brasses with white metal lining, while the top bearings consisted of cast steel bearing caps, white metal lined. The workmanship was generally excellent throughout, and the construction had the appearance of substantiality. A successful trial trip, and as a result thereof the delivery of the ship, was consummated.

Gradually but surely, however, one defect after another developed. First, a very noticeable wear developed in the after (low-pressure cylinder) bearings. Cylinder heads cracked, and kept on breaking despite their thickness being greatly increased when rebuilt. Then were heard complaints of heavy vibration in the valve gears and of the engine cylinders. On one occasion while under way, under apparently ordinary working conditions, the ahead eccentric rod of the intermediate-pressure valve gear broke, twisting itself into a shape suggesting the appearance of a bow.

At times considerable water was carried over with the steam into the cylinders, keeping the relief valves popping and douching the engine-room force. Just when starting on a trip on a certain occasion the cylinder cover of the electric light

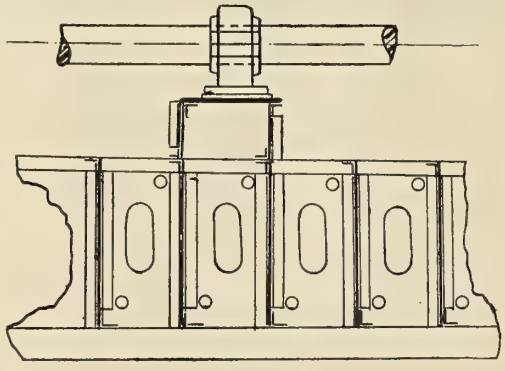


FIG. 2.

engine broke, disabling the electric light plant and putting out of commission all lights, as the storage batteries, of which there was a complete installation, had been allowed to run out without recharging. The boilers gave no trouble except for occasional foaming, and the ship generally stood up well against its oftentimes extremely severe service. One exception was the breaking of the rudder quadrant, Fig. 1, at the root of the tiller, not from any flaw in the forging but from strains not provided for in its design. The spare tiller carried on board was rigged up, and the ship reached its destination safely. The foundations, Fig. 2, of the steady bearings became loose from working, due to improper disposition of their scantlings and faulty construction. The forward crankslab twisted out of position, causing disarrangement in the alinement of the high-pressure crankpin.

It became very evident to those concerned that a series of different causes contributed to this most unsatisfactory state of affairs, and to prevent complete disablement, remedies had to be found and applied.

CAUSES.

A primary cause for many ills exists in the fact of overrating one's capacity. The most serious troubles with the engine in question were undoubtedly due to the attempt to develop power of which it was incapable, and which could only be procured at a penalty. The engine, it is believed, was designed for about 1,100 horsepower, which could not be

obtained with the size of high-pressure cylinder provided and ordinary work of expansion, but was secured by admitting live steam directly into both receivers.

It may be readily conceived, even by those not fully conversant with theoretical engine design, that a definite steam weight, as represented by the cylinder volume before cut-off at a certain pressure or density, allowing for known losses for the type of engine chosen, is necessary to develop a given horsepower, the steam weight thus admitted being meanwhile expanded down to a given terminal pressure in the other cylinders. If the original steam weight admitted at the beginning of each stroke, or, in other words, the piston area, together with its speed, is not great enough, then the difference in steam weight required for the horsepower must be admitted direct to the other cylinders to give the stipulated power. This is commonly done through the by-pass valves to the receivers. This action results often in serious differences as to the work developed by each cylinder, the low-pressure cylinder usually giving the highest power, then the intermediate-pressure cylinder, while the least is obtained in the high-pressure cylinder, being due to increased back pressure on each succeeding cylinder from the low-pressure cylinder on.

Owing to the highly unequal work developed by the cylinders inharmonious loads are transmitted to the bearings with excessive wear on those most heavily loaded.

A more serious question, however, arises through the augmentation of receiver pressures, especially when the valves, as were the conditions in the engine in question, are of the unbalanced slide valve construction. The pressures on these valves were, respectively, in the intermediate-pressure and low-pressure cylinders under ordinary running with by-passes closed about 12 and 6 tons, and considerably more when open. The friction between valve and valve seat to be overcome, together with the inertia forces, brought a very excessive strain on the valve gear, causing at the same time undue vibration. Add to these severe conditions the omission of continuous and skillful lubrication of the gear and the eccentrics, which, as mentioned before, were working cast iron on cast iron, and the results are obvious. Investigation later actually demonstrated that the eccentrics of the intermediate-pressure valve gear had been running without proper oiling for some time previous to the accident. The natural result was heating and abrasion, together with expansion of the metal so great that a firm grip by the strap on the sheave made further turning impossible. Strap and sheave therefore practically became one, with the motion bending the lower end of the rod and pulling the entire valve gear downwards as far as the valve chest would permit, until the stress finally was transmitted through the length of the rod to the upper neck, at which place the rod broke. After breaking the rod struck the bedplate, and was carried around by the eccentric until twisted into a complete bow before the engine was stopped. The gear and valve were removed, and the trip continued with the engine working compound with the high-pressure and low-pressure cylinders.

To have water carried over with the steam into the cylinders is a serious drawback, and the cause of such occurrence apparently originates in different ways. In the case which we have before us the cause was plausible enough. The boilers were 13 feet 3 inches in diameter, with the stop valves about 14½ feet from the inner bottom, and the height to the throttle inlet at the middle of the valve chest on the engine was about 13½ feet, counted from the same base, which, together with the trim by the stern of the ship, produced a net incline in the main steam pipe leading from boilers to engine of nearly 1 foot. Saturated steam nearly always contains a percentage of moisture, which, together with the water carried over, in case of foaming and under conditions outlined, owing to gravity, drained into the engine instead of into the boiler, where it would be harmless. The greater part of the water coming over as indicated may be taken up with a separator. This device, however, was omitted in the design. In engines of long stroke, with the steam inlet considerably above the boiler outlet, no separators are needed and are not fitted, but they should be fitted when the relative position of engine and boiler is such as to render flow by gravity towards the engine certain. Aside from the economic loss sustained by water being admitted to the cylinder no other damage need be sustained if efficient means are provided for eliminating its action, usually done by cylinder relief valves. If these valves are tampered with, however, as by setting up on the springs or removing the valves entirely and plugging the holes, trusting to luck to care for consequences, then in ten cases out of ten such trouble will ensue as breaking of cylinder heads and other strained situations as were here experienced.

An essential precaution before starting up an auxiliary engine, or any engine, be it reciprocating or turbine, consists in opening all drains so as to get rid of the water which, by condensation, is bound to accumulate in the steam piping or in the engine when standing. Long steam pipes usually have and should have for protection a stop valve near the boiler, or where a branch pipe joins the auxiliary pipe. Such valves are, unfortunately, difficult to keep absolutely tight, and for that reason leakage occurs. If suddenly opened, at the same time starting the engine, a large amount of water finds its way into the cylinder, flooding it completely if it is small. A few revolutions in a quick-turning engine, like dynamo engines, may, under the conditions cited, cause irreparable injury. The top cover is generally much weaker than the bottom of the cylinder, and, as happened here, is the member that is smashed.

The electric light engine, which was directly connected to the dynamo, stood on the main engine floor plates, and had thus the benefit, so to speak, of a long steam sleeve, shaped to effectually trap all the steam that condensed in it. A careful artificer sees to it before starting his engine that the entrapped water is drained off.

While a built-up crank-shaft may be made as rigid as a solid shaft it is very important to be sure that all crank arms are shrunk on under sufficient pressure to ensure rigidity, and, moreover, to fit the keys to bear tightly not only top and bottom but also on the sides. The forward crank arm, theoretically, sustains no other torque than that due to friction in the forward journal, which is immaterial, and the key here was either overlooked entirely or badly fitted, hence the disarrangement of the pin with the consequent eccentric motion of the journal, which no amount of ordinary adjustment was sufficient to remedy.

While it may appear to one who only casually observes the function of steady bearings, placed at different points along the length of the line shafting, that they only oppose the pressure caused by the weight of the shaft, it soon becomes apparent that there exist besides both lateral and fore and aft stresses. These have to be effectually provided for in the design and construction of the foundation. Building these foundations, as was done in this engine, of a couple of vertical plates riveted to the standing flange of adjoining frames, with a foundation plate fastened at the top without further intercostal or diagonal bracing rendered the foundation insecure, and after a few months' operation every rivet became loose and the entire structure unfit to carry the bearing with steadiness. The breaking of a shaft may have resulted from such cause, but the mischief was discovered in time.

REMEDIES.

While the nature and cause of these numerous and annoying accidents was fully understood it became of concern to those interested to apply such remedies as would result in the least delay in the service of the ship, at the same time to obtain a smooth working valve gear and engine with but little reduction in the engine horsepower.

In order to equalize the work among the three cylinders, cards were taken before any change was made, giving the following results:

High-pressure	239.3
Intermediate-pressure	432.2
Low-pressure	419.7
Total	1,091.2

Vacuum gage	25½ inches.
Revolutions per minute	112
Intermediate-pressure receiver	70 pounds gage.
Low-pressure receiver	12.8 pounds gage.

The first alteration consisted in renewing all eccentric straps, lining same with white metal.

The next change involved resetting of the valves at the same time redesigning the laps, cut-offs, leads, releases and compressions so as to reduce the receiver pressures with earlier cushion. This was done in the following manner:

The angular advance on the low-pressure valve gear was reduced from 36¾ degrees to 34¾ degrees by throwing the eccentric back and fitting a new key having a jog above the

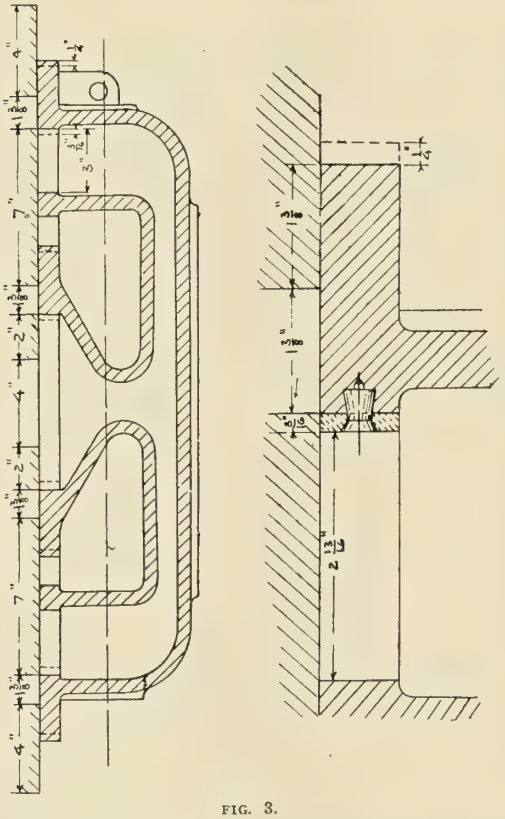


FIG. 3.

shaft. The steam laps were cut off ¼ inch and 11/32 inch top and bottom, respectively. The exhaust laps were added to 3/16 inch and 5/16 inch, respectively, top and bottom, Fig. 3. Then,

	Inches.
Steam lap top	1⅜
Exhaust lap top	+ 3/16
Steam lap bottom	1 5/16
Exhaust lap bottom	+ 5/16

Reducing the steam laps was easily performed by cutting down original laps in a planer, but the addition of exhaust laps was more difficult. It was consummated, however, by riveting planed brass strips to the inside ports of the valve, using soft brass rivets in conical holes cut by a special drill in the edges of the valve. The cut-off was thus changed from .68 to .75, the lead and compression beginning at an earlier stage than before.

It was desirable, also, to throw back the intermediate-pressure eccentric, the angular advance of which was 34½ degrees; but this was not done owing to it being impossible without first raising the shaft, for which there was no time. Similar changes to those made in the low-pressure valve were made, however, in the intermediate-pressure valve, in order to secure a steam distribution giving the same results as aimed for in that cylinder. The cut-off was thereby changed from .7 to .78, with leads, compression and releases in accordance. The changed laps for this cylinder were:

	Inches.
Steam lap top	1 9/32
Exhaust lap top	— 1/16
Steam lap bottom	1 7/32
Exhaust lap bottom	+ 1/16

The high-pressure eccentric, which originally had 31 degrees angular advance, was not reset, but steam laps were cut off 3/16 inch and 7/32 inch top and bottom, respectively, as were also the exhaust laps 3/16 inch and ⅛ inch, giving the following laps for this cylinder:

	Inches.
Steam lap top	1 7/32
Exhaust lap top	— 3/16
Steam lap bottom	1 3/16
Exhaust lap bottom	— 1/8

This produced a change in cut-off from .75 to .79. Owing to the fact that the eccentric rods in this gear were crossed a slight amount of "linking up" changed the cut-off rapidly without materially altering leads, compression or releases, which proved of great advantage in final adjustments. All valves had 6-inch throw.

The effect of the foregoing changes may be appreciated from the following results obtained from cards after changes had been made:

High-pressure cylinder	301.4
Intermediate-pressure cylinder	376.8
Low-pressure cylinder	368.7
Total	1,046.9

Revolutions per minute	105
First receiver	62 pounds gage.
Second receiver	9.2 pounds gage.
Vacuum	26 inches.
Boiler	168 pounds gage.

As the foregoing changes were made with a view to secure a smoother and easier working valve gear it became interesting to note the results. Not only did the engine permit of easier handling, but there was also almost an entire absence of vibration in the gear as well as in the engine as a whole. By increasing the volume, through lengthened cut-off in both cylinders, the receiver pressures were correspondingly lessened, at the same time as the back pressure was reduced on the high-pressure piston, adding to the power of that cylinder. While the cut-off by the change made in this cylinder was lengthened with an earlier lead a small amount of "linking up" brought the cut-off to normal, while the lead and other quantities remained practically unchanged, owing to the fact that the rods were crossed.

By a slight change in the lead of the steam pipe, obviating the drain of the entrained water in the steam towards the engine, together with the addition of a separator, no trouble was further experienced from water in being carried over towards the cylinders.

All the relief valves were refitted and readjusted, thereby insuring safety. The foundations of all steady bearings were

rebuilt with brackets and intercostals to compensate for both fore and aft and lateral stresses existing. All bends and lines of piping where there existed any possibility of condensed steam and water collecting were furnished with efficient drains.

When rebuilding the rudder quadrant the dimensions of the arm were increased so as to give a sectional area almost twice what it originally was, beside carrying the chain plate well over the boss, giving a better distribution of material. The spring bearing foundations were strengthened with intercostal plates and angles to resist fore and aft movement.

With the above changes, together with careful operation and efficient maintenance, the machinery afterwards worked satisfactorily. D. C.

An Experience with a Sea-Cock.

Next to absolute safety, simplicity should be most aimed at in all parts of the machinery of a ship, but in no place perhaps is there greater need of careful consideration than in the arranging and designing of the sea and bilge fittings, so that through neither accident, carelessness nor ignorance on the part of an engineer can the safety of the ship be endangered. It is unnecessary to say here how easily a vessel may be flooded by a badly arranged system of sea-cocks in ignorant or inexperienced hands, for it is self-evident to every engineer; nor is it necessary to recapitulate the names of vessels that have foundered from accident to or neglect in the careful working of these fittings, for almost every engineer has heard of them.

Lloyd's Committee have issued special rules on this subject, and the Board of Trade and other similar corporations are no less vigilant in endeavoring to eliminate every source of danger. The Board of Trade regulations, referring to sea connections, say that: "All inlets or outlets in the bottom or side of a vessel, near to, at, or below the deep-load waterline, other than the outlets of water closets, soil, scupper, lavatory and urinal pipes, should have cocks or valves fitted between the pipes and the ship's side or bottom; such cocks or valves should be attached to the skin of the ship, and be so arranged that they can be easily and expeditiously opened or closed at any time, and the cocks, valves and the whole length of the pipes should be accessible at all times." Cocks or valves standing exceptional distances from the ship's plating; that is, where the necks are longer than is necessary for making the joint, should not be passed without the sanction of the Board of Trade, and one condition of their being passed is that they should be made of gunmetal and well bracketed.

What mischief may be caused by a deficient sea-cock and its connections is fairly well illustrated by an experience the writer had some years ago, when engineer in one of the vessels engaged in the Belgian Mail Service, running between Antwerp and South American ports and River Plate. This steamer was equipped with a compound engine of about 2,500 indicated horsepower, of the old lighthouse or steeple type, *i. e.*, a single crank, with the high-pressure and low-pressure cylinders tandem, and having a 15-ton balanced fly-wheel 13 feet in diameter on the thrust shaft abaft the after bearing, which bearing also took the thrust from a large, single collar solid on the shaft, rubbing on a correspondingly large flange on the after end of the after-bearing brasses.

The rim of the fly-wheel was not more than 16 or 18 inches clear of the ship's plating, and ran between the two after frames in the engine room; it will therefore be evident from this fact that it was very necessary to keep the bilges as free from water as possible, otherwise if more than 18 inches of water was permitted to accumulate the engine-room soon became deluged with the bilge water flying from the rim of the wheel. The orders were not more than 9 inches in the bilges at the relief of the watch. On this particular occasion the vessel was well to the southward of the line, making for Rio Janeiro, when we ran into a pampero, and experienced very heavy weather for two days, the ship laboring heavily; the engineers were put on double watches, and one was required to be constantly at the throttle valve to ease the engines and prevent damage from the heavy racing. Large quantities of water had been shipped, coming down the fiddleys into the stokehold, washing coal and ashes into the bilges, and continuously choking the mud-boxes, stopping the bilge pumps, and it was only by putting the donkey pump to work, in addition to the bilge pumps, that we were at all able to keep the water below the stokehold plates, which, by the way, were some 5 or 6 feet lower than the bottom platform of the engine room. Everything generally was in a pretty uncomfortable state, as it was impossible to get the water down so that the rim of the wheel would not lift it and whirl it all over the engine room; canvas, meanwhile, had been placed over the fiddley gratings, the water service in the engine room and tunnel was shut off, and everything possible was done to reduce the water.

On the afternoon of the third day, when the weather was at its worst, the attention of the writer was arrested by the increased volume of water that apparently was being lifted by the fly-wheel; a hurried examination of the donkey pumps disclosed the fact they were working well, as the mud-boxes had only a short time before been cleaned. Sounding the bilges, it was found the water was rapidly gaining; all the engineers were called, and they were sent individually to make an examination for leaks in the boiler room, tunnel and engine room; the circulating pump and connections, condenser and all the piping arrangement, as far as could be seen below the plates, were examined, but without offering any solution to the mystery.

The situation was now becoming desperate. As the wing plates in the stokehold had been washed up the bunker doors in the wings had to be closed, and the water was now in the ash pits of the lower fires. The bilge injection was opened, and for some little time the water did not gain upon us; but, unfortunately, the tail pipe was not fitted with a rose box or basket, but had the end stopped up, and was perforated with a number of small holes, which soon became choked by the coal and ashes that had been washed into the bilges. Efforts were, of course, made to keep it clear, but owing to the depth and wash of the water it was impossible for a man to do this.

Meantime the writer was making a closer examination of the pumps, and in doing so unconsciously was feeling the plungers, when he was struck by feeling the pump plunger of the sanitary pump warm. Now, this pump was single-acting; worked from the inside of the pump levers, and was of short stroke. It had its own separate 2-inch suction direct from the sea, and should therefore, when working properly, have been cold. Following this clue he found the suction pipe also warm, and could not understand why this should be so.

The sea-cock for this pump was well down on the ship's bottom, and was covered by this time with 6 feet or more of water, so that it was only by diving that trouble here could be ascertained. This was a matter of no little danger and difficulty on account of the swirl of the water with every roll of the ship. However, it had to be attempted, and so fastening a rope under the arms, and getting the second engineer to stand by with men to haul when necessary, the dive was made, only to find the water pouring into the ship with tremendous force and velocity at this point. As far as could be felt the cock was intact, and very fortunately the cock was fitted with a ring similar to a blow-off cock, and arranged so that its handle or spanner could not be removed when open. It is probably owing to this that the vessel was saved. It required quite a few dives below the slimy, oily water before the cock was fully closed, but it was accomplished successfully, and the pumps soon

began to tell upon the water, but it was not before the lower fires were out entirely and the steam had fallen so low that the engines would scarcely go over the center.

It can readily be imagined that all breathed more freely as the water steadily receded in the bilges, and the stokehold plates were put in place again and the fires got under way. Soon after the weather moderated and Rio was reached in due course, where the bilges were thoroughly cleaned and the damage to the offending suction pipe repaired. It was found that the brazing of the copper pipe to the flange had given way, and the pipe had sprung back a clear foot from the flange, so that the South Atlantic Ocean had a clear 2-inch diameter hole to pour its water into our bilges.

Constant watchfulness and careful examination periodically should be made of all sea-cocks and connections to avoid danger, or, if possible, accident, for it is well known to engineers that mischief may ensue from the corrosive action of bilge water on metallic surfaces; iron corrodes quickly unless well protected, and Muntz metal has been found to decay in a peculiar manner, becoming so soft that it can be cut like plumbago. A good, thick coat of Portland cement will give protection at times, although the writer has found sea-cocks held in place only by cement, the through bolts having been entirely corroded away, and the thickness of the ship's plating reduced 50 percent under the flange of the cocks by corrosion and galvanic action. This has, of course, been remedied in dry-dock. Finally, sea-cocks and valves should be so placed that they are accessible practically at all times, and as far as possible within sight from the working platforms of the engine room.

John Creen.

Seattle, Wash.

A Peculiar Accident.

While visiting the chief engineer of an 8,000-ton steamship with a large triple engine, my attention was called to a brass plunger which had been removed to be replaced by a new one. The plunger belonged to the main feed pump and was part of an attached pump outfit, being driven by the air pump crosshead attached to the low-pressure engine. It was about 6 inches in diameter, and some 5 feet long, the upper end being tapered in the usual manner, to fit the air-pump crosshead, and with a thread on top. Cast brass was the material cored out on the inside, leaving the body about ⅜ inch thick. The curious feature of the accident to this simple part consisted of the fact that after long years of wear it had suddenly collapsed, a section through the middle roughly resembling a three-toothed gear. The grooves were nearly parallel and extended close to either end.

The pump to which the plunger belonged was of cast iron, bolted by a flange to a pad cast on the air-pump body. There were two valves, one suction and one discharge, cast with the pump, each with its usual bonnet. The valve seats were of brass, forced into the cast iron and doweled in place. The valves were of the usual check type, also of brass, with a 45-degree angle seat, whose lift was limited by a projection cast in the pump body. There were two relief valves discharging to the bilge, one connected to the chamber between the suction and discharge valves and the other in the discharge pipe, also the usual suction and discharge pipes which completed the outfit.

It was in the middle of a run of several hundred miles that the suction relief valve suddenly started to blow, discharging to its full capacity into the bilge. The pump was promptly cut out, the auxiliary feed and independent simplex pump taking its place. The plunger continued to run idly during the balance of the trip. When the first opportunity offered, both bonnets of the pump were removed in an effort to locate the cause of the trouble, but, strange to say, everything was found in first-class shape. An extended examination was then made by most every member of the engineers' force, but failed to locate any trouble. The pump was assembled and the next trip started, but the pump had to be cut out immediately, due to the same cause as before. A second examination proved no more than the first and a third attempt to use the pump ended in a similar manner. The conclusion was now reached that the trouble must be in the relief valve, so when it was discharging the nut regulating the tension of the spring was set up.

The effect was instantaneous; a column of water appeared to come up through the plunger, drenching that portion of the engine room and its occupants, which was not lessened until the auxiliary feed pump once more took care of the boiler feed. The broken-down plunger appeared to run all right in its place and no stop was made, but a very determined effort to locate the cause of the disaster was indulged in when the opportunity again came to hand.

After a considerable time the trouble was finally located in the discharge valve seat, which had sheared its dowel and had risen bodily, seat and all, when the water had collected below it. The above mentioned stop, limiting the lift of the valve, had not allowed the seat to leave the casting, but had effectively kept the valve closed. Upon examination as the valve and its seat were in their usual positions the evidence of the mischief was concealed. When the added pressure put upon the relief valve kept this from opening to release the water, it naturally found an outlet at the weakest point, which fortunately was the plunger and not the complicated pump-body casting.

As a spare plunger was carried aboard ship the damage was soon repaired; both valve seats being securely anchored in place, as a matter of course.

Camden, N. J. Wm. J. Auten.

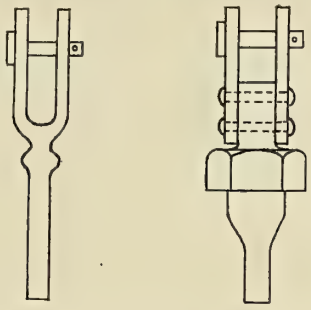
Squealing Valves.

It is the object of every good marine engineer to economize cylinder oil as much as possible, as it is an expensive item, and except where superheated steam is used the steam itself should afford quite enough lubrication for the valves and cylinders of the engine when once steady running has been started. The usual time when lubricating oil is required is when the boat is being worked out of port, and a certain amount of starting and stopping and slowing down may be necessary. Once, however, a steady run is obtained it should be possible to shut the oil supply, either entirely off, or down to a very small minimum. The ordinary D-flat valves, which are used in connection with high-pressure and medium-pressure cylinders of marine engines, have, however, a rather nasty habit of squealing. This not only spoils the valve faces, but the trouble involves the use of a lot of cylinder oil to keep the valves quiet. In one case of this kind the high-pressure valve was always making a noise, and when the boat arrived in port it always became necessary to deepen the oil-ways, which were found to be practically ground out. After some discussion of this problem it was decided to drill and tap holes all over the face of the valve 1⅛ inches in diameter, and to screw into these white metal plugs. These were then riveted over in order to prevent any subsequent working loose, and were then filed off flush with the valve face. When it was put back again the valve was given a good flush of cylinder oil before closing up the valve, and this procedure was sufficient to cure the trouble. Twelve months afterwards the oilways were in perfect condition, and the squealing noise was entirely done away with, the white metal in the valve face being in itself a lubricant and saving a good deal of cylinder oil.

Chas. P. Starkweather.

A Broken Goose Neck.

A marine engineer often has to overcome trouble that does not strictly belong to his own department. Occasionally the deck officers get into trouble and then the man with the hammer and chisel is called in to get them out of it. On one occasion the goose-neck of a boom broke off at the fork, due



ORIGINAL GOOSE-NECK AND IMPROVISED ARRANGEMENT.

partly to a flaw in the forging, and also in some measure to excessive strain in working. It was impossible under the circumstances to forge a new one, but yet it was absolutely necessary to have the boom working in order to get a cargo into the vessel.

Fortunately, however, a small stanchion about the diameter of the spindle of the goose-neck was found on board, and one end of this was "jumped up" and flattened for about 9 inches along its length. Two holes about 1¼ inches diameter were then drilled through this flattened part, and two pieces of 1-inch plate were drilled, with holes to correspond. The three pieces were then riveted together, the flat plates projecting outwards and in the same straight line as the stanchion. These plates were each about 3½ inches wide. A large nut was fitted on the remaining "jumped up" portion of the stanchion to take the place of the collar in the original goose-neck, and the pin was taken out of the old goose-neck and fitted into the new arrangement. This, as a matter of fact, was the only part of the old arrangement which was placed in the new. The sketch shows a comparison of the original and improvised arrangement, the latter of which may, with all due modesty, be described as ingenious. OLIVER D. QUINCY.

An Exceptional Photograph.

On June 10, 1909, the steamship *Hyades,* of the Boston Towboat Company, sailed from San Francisco, Cal., on her regular trip to the Hawaiian Islands via Puget Sound ports. Shortly after leaving San Francisco she ran into a strong northwesterly gale with a big head sea running. The ship was light, carrying only her fuel oil (about 5,000 bbls.), and with the continual pitching was racing heavily, at times throwing her stern to such a height that the shoe could be plainly seen. When off Cape Blanco, on the Oregon coast, the writer devised a plan for obtaining the accompanying photograph of the propeller while racing.

A small boatswain's chair was rigged with guy lines leading fore and aft, sailors stood by each of the guy lines, and I was tied in the chair with another line made fast under my arms. The first mate and two sailors then lowered me over the ship's stern on the starboard quarter until I was on a level with the revolving blades. After five unsuccessful exposures, when both myself and the camera had to be hauled on deck several times on account of being completely submerged, I finally succeeded in getting the picture shown. It was taken at a dictance of 10 feet from the wheel, which was making over 100 revolutions per minute. This is supposed to be the only picture of its kind ever taken.

PROPELLER PHOTOGRAPHED WHILE RACING. *(Copyright by H. E. Rylatt.)*

The *Hyades* is 361 feet long, 47 feet beam, 28 feet depth, with at tonnage of 3,753. She is driven by a triple-expansion engine with cylinders 21, 35 and 56 inches diameter and 42 inches stroke. The indicated horsepower is 1,650, and the diameter of the wheel 14 feet 9 inches. The fuel consumption is one-half barrel per mile, or 1.2 pounds per indicated horsepower per hour. H. E. RYLATT.

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Naval School of Marine Engineering.

As announced last month, we are publishing in this issue a description of the new United States Naval School of Marine Engineering. This school is one development of the plan inaugurated in 1899 for the amalgamation of the engineer and line officers in the navy. Since that date the Naval Academy itself has been developed very largely along engineering lines, but from the nature of things the enginering work undertaken by the undergraduates of the Academy has been of a general nature, embracing many different branches, and there has been no opportunity for specializing in marine engine design. It is, perhaps, not too much to say that there is no branch of naval work which requires more thorough study or a broader knowledge of engineering than the subject of marine engine design. It is one of the fundamental branches of naval work, and the greatest efficiency cannot be maintained in the navy unless this important branch is developed to the highest degree. The establishment of the new post-graduate School of Marine Engineering is, therefore, a matter of no little importance.

While it is necessary that such a school of engineering develop a certain number of expert designers trained for the work in hand, yet it is evident that the institution would lose a valuable opportunity if it did not in some way influence the entire engineering personnel in the navy by stimulating interest in a broader and more thorough study of engineering subjects. In working out the details of the new school this feature has been kept in mind, and by making appointments to the school a reward for exceptional ability and achievement in engineering work, as well as arranging that such an appointment will lead to positions of increased responsibility and opportunity, it has already stimulated great interest in engineering work among the line officers, and appointments to the school are eagerly sought.

Although it is too soon to tell how well the purpose of the school will be accomplished, nevertheless the method of selection, the method of instruction and the disposition of graduates of the school indicate that the desired results will be achieved, and that in a few years the navy will be provided with an efficient corps of expert designing engineers. The method of selection, as outlined elsewhere in this issue, is one well calculated to secure not only men of exceptional mental qualifications, but also men of practical achievement, who have had an opportunity to show their worth in practical engineering work. Naturally, with such students as these the method of instruction adopted in the school must be such that the students will have ample latitude for original work and the carrying out of their own ideas. In fact, much of the work of the school will be research work, and it will consist largely of individual reading and investigation.

It has frequently been said that a designer is merely a copyist who carries the work of his predecessors a step further. This is true, and, therefore, the education of designing engineers must necessarily embrace a thorough knowledge of the methods and work of previous designers. If any adverse criticism of the school were to be made, it probably would be that the time allotted to the actual work of designing is rather meager. However, a few years' experience will show whether this is so or not.

Comparative Cost of Operating American, British and German Steamships.

In the course of an investigation which is now being carried on before a special committee of the American House of Representatives in connection with certain matters relating to ship subsidy legislation, some interesting data regarding the comparative cost of operation of American, British and German steamships were brought out by Mr. A. H. Bull, of New York. Mr. Bull stated that he has two freight steamships of practically the same size, one of which is operating under the American flag and the other under the British flag. The total wages of the crew on the American ship per month are $1,470 (£301.9) and on the British ship $897.04 (£184.2). The American

ship is required to carry seven more men than the British ship, and, furthermore, the American ship is never allowed to leave port without a full complement of officers and men, whereas the British ship, in case of desertions, can pick up her crew in various ports as may be convenient. As a matter of interest, Mr. Bull also secured from the German Naval Records a schedule of the pay for a German crew on a similar steamship operating under the German flag. The total wages of the German crew per month are only $483.82 (£99.3), as against $897.04 (£184.2) for the British ship and $1,470 (£301.9) for the American ship. The American captain is paid $175 (£35.9), the British captain $100 (£20.5) and the German captain $79.75 (£16.4) per month. The American chief engineer is paid $150 (£30.8), the British chief engineer $97.20 (£19.9) and the German chief engineer $79.75 (£16.4) per month. It is therefore evident that the American steamship owner is greatly handicapped in competition with either the English or German ship owner in the cost of operating his vessel. Also, the British steamship owner has a considerable handicap to overcome in competition with the German owner. The handicap of the American owner is, however, made still greater by the federal requirements in the matter of outfit, including victualing. This difference was stated by Mr. Bull to be as great as the difference in the wages of the crews. Although the wages paid to German crews are apparently exceptionally low, it should be borne in mind that the German captains, at least, frequently receive, in addition to their regular salary, primage, or a certain percentage of the gross receipts from the freight on the voyage. Taking this into account, the compensation of German and English captains is more nearly equal.

When it comes to the comparative requirements for British and American engineers, as the law now stands, no officer or engineer who has secured a license from a foreign nation is allowed to take the examination for a similar position under the American flag without serving additional time in an American vessel. According to this law, therefore, British and Scotch marine engineers, who have a world-wide reputation as masters of their craft, cannot take charge of an engine in an American ship until they are naturalized, which takes three years, and during that time they must serve in a subordinate position on the American vessel, notwithstanding the fact that they have already spent from six to seven years in England or Scotland to obtain their licenses, while the American engineer is enabled to obtain his license in three years. Furthermore, the British or Scotch marine engineer must serve two or three years in a machine shop, after which he must serve three or four years on board ship, while the American engineer is not obliged to serve any time in a machine shop, and is, therefore, very apt to lack the thorough mechanical training which must necessarily be acquired by the British or Scotch engineer before he can obtain his license, unless, as is frequently the case, the American steamship company gives preference to men who have had machine shop experience when taking new men into their service.

The foregoing instances serve to give some idea of the discrepancies existing in the conditions which govern the operation of steamships under the British, German and American flags. In many cases the American navigation laws are antiquated and work unnecessary hardship on the American ship owner, whereas by changing them to conform more nearly to British or German practice nothing would be sacrificed either to safety or to efficiency, and the unnecessary restrictions would be avoided. It is to be hoped that some action will be taken in this direction in the near future.

New French Destroyers.

Considerable interest attaches to the trials of the new French destroyers on account of the opportunity afforded for a comparison of various types of propelling machinery under practically similar conditions. These destroyers were built primarily for experiment, and a sufficient number were ordered so that three different means of propulsion could be compared, namely: reciprocating engines, turbines and a combination of reciprocating engines and turbines. Moreover, several different types of turbines have been used, one of which at least is making its first appearance in the marine field.

Disregarding the design of the boats from a military point of view, since they are admittedly built principally for experimental purposes, the point which deserves most careful consideration is the comparative results of the different modes of propulsion. Although all of the boats did not prove successful, yet sufficient data is at hand to indicate in a general way the superiority of the reciprocating engine at speeds ranging from 10 to 25 knots. At cruising speed, therefore, the reciprocating engine can be taken as considerably more economical than the turbine drive, and it gives slightly better results than the combined reciprocating engine and turbine. The boats driven by turbines alone show excessive coal consumption up to 25 knots, but above that they give better results. The best results, however, were obtained with one of the boats equipped with a combined reciprocating engine and turbine drive. This showed nearly as good results at cruising speeds as the reciprocating engine-driven boat, and practically as good results as the turbine-driven boats at full power. Furthermore, a speed of .9 knot more was realized with this type. The higher speed, however, is very largely due partly to the design of the hull, which, as explained elsewhere in this issue, involves features not hitherto used in this type of boat.

As a result of the experience gained with these boats, the French Admiralty are now adopting turbines for their destroyers, considering them a necessity in order to gain the high speeds desired.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		May 1.	June 1.
BATTLESHIPS.					
Florida	20,000	20¾	Navy Yard, New York.....	63.4	66.3
Utah	20,000	20¾	New York Shipbuilding Co..	72.0	76.0
Arkansas ...	26,000	20½	New York Shipbuilding Co...	24.0	27.6
Wyoming ..	26,000	20½	Wm. Cramp Sons.....	19.0	22.5
TORPEDO-BOAT DESTROYERS.					
Paulding ...	742	29½	Bath Iron Works.....	86.8	89.4
Drayton	742	29½	Bath Iron Works.....	77.6	82.5
Roe	742	29½	Newp't News Shipbuilding Co.	85.1	88.7
Terry	742	29½	Newp't News Shipbuilding Co.	82.4	86.9
Perkins	742	29½	Fore River Shipbuilding Co...	72.9	79.6
Sterrett	742	29½	Fore River Shipbuilding Co...	71.4	77.1
McCall	742	29½	New York Shipbuilding Co....	66.9	76.5
Burrows	742	29½	New York Shipbuilding Co...	65.6	72.7
Warrington..	742	29½	Wm. Cramp & Sons.....	67.5	68.3
Mayrant	742	29½	Wm. Cramp & Sons.....	72.6	73.9
Monaghan ..	742	29½	Newp't News Shipbuilding Co.	18.3	19.9
Trippe	742	29½	Bath Iron Works.....	31.9	38.8
Walke	742	29½	Fore River Shipbuilding Co...	27.5	32.1
Ammen	742	29½	New York Shipbuilding Co...	30.9	40.4
Patterson ...	742	29½	Wm Cramp & Sons.....	17.8	23.0
SUBMARINE TORPEDO BOATS.					
Salmon	...	..	Fore River Shipbuilding Co..	92.7	94.7
Seal	...	..	Newp't News Shipbuilding Co.	48.9	50.1
Carp	...	..	Union Iron Works.....	47.6	53.5
Barracuda ..	...	..	Union Iron Works.....	47.6	53.5
Pickerel	...	..	The Moran Co.....	46.4	50.4
Skate	...	..	The Moran Co.....	46.1	50.4
Skipjack	...	..	Fore River Shipbuilding Co..	37.6	40.1
Sturgeon ...	...	..	Fore River Shipbuilding Co..	36.7	38.9
Tuna	...	..	Newp't News Shipbuilding Co.	22.2	26.2
Thrasher ...	...	..	Wm. Cramp & Sons.....	4.7	5.7

ENGINEERING SPECIALTIES.

Keuffel & Esser Duplex Slide Rule.

An improved form of patented duplex slide rule has been recently placed on the market by the Keuffel & Esser Company, 127 Fulton street, New York. The most recent improvement is the L-shaped end plate, which enables any desired adjustment of the slide to be secured by loosening a screw which passes through the upper portion of one plate, is threaded into the other and fits an elongated hole in the outer section of the slide rule. Loosening the screws at each end of the rule permits the movement of this outer section either in or out to give any desired friction on the slide without disturbing the longitudinal relation of the scales.

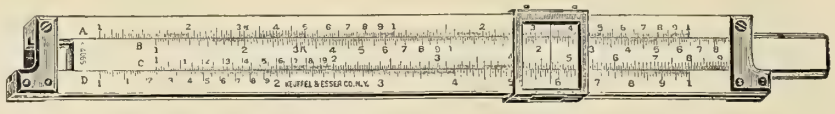


FIG. 1.—FRONT VIEW OF NEW ADJUSTABLE DUPLEX SLIDE RULE.

FIG. 2.—BACK VIEW OF THE RULE, SHOWING THE INVERTED SCALES.

The duplex slide rule is so named because it is graduated on both faces, thus giving practically two rules in one. It is formed of three parts, the two outside pieces constituting the body of the rule and the other the slide. The slide being the same thickness as the rule the surfaces of both are flush, and all the graduations are on the exterior, where they may be readily seen and utilized by simply turning the rule over.

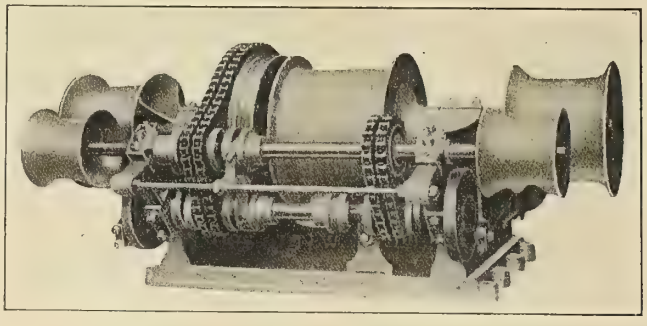
The front face of the duplex slide rule, Fig. 1, is graduated like the familiar Mannheim rule, with all four scales progressing from left to right, while the reverse face, shown in Fig. 2, has the *A* and *D* scales graduated in the customary way, while the *B* and *C* scales are inverted and progress from right to left. The slide in addition to the two inverted scales has the scale of tangents usually found on the back of the slide of an ordinary rule. The indices of the scales on one face are in alinement with those on the other face, and a runner encircling the whole rule enables coinciding points on any scales of either face to be found at once.

The principal advantage of the inverted scales lies in the reduction of the operations required to perform many problems, with a consequent saving in time and increase in accuracy. This is because when setting to quantities on the inverted scales the reciprocals of these values, with respect to the regular scales, are given. Thus the operations of multiplication and division are reversed, and what is a dividing operation with the regular scales becomes a multiplying process with the inverted ones.

These patented duplex slide rules are made in 5, 8, 10, 16 and 20-inch lengths, with and without trigonometrical scales.

David Wilson's Patent Noiseless Winch.

David Wilson's Patent Noiseless Winch Company, 21 Water street, Liverpool, have on the market a winch which is operated by sprockets and chains. The chains operate on three-fourths of the main barrel wheel, thus distributing the weight nearly all over this wheel instead of working with one tooth, as in the ordinary winch. The chain being double catches on ten teeth

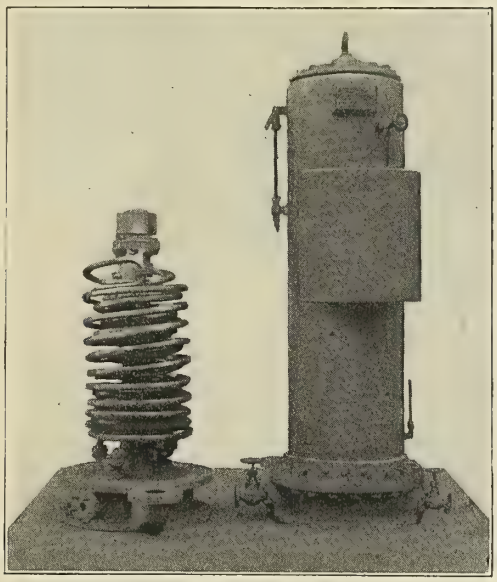


on the smallest pinion of the intermediate shaft, which is fitted with adjustable bearings to regulate the chains. The chains are of the roller type, made of the best steel, case hardened, and tested to 12 tons each. It is claimed that the wear in this type of chain is on the whole length of the pin, and that no wear whatever takes place on the links. It is also claimed that as there is a free motion and very little friction this winch will lift as much weight at 40 pounds pressure as the usual winch will lift at 60 pounds pressure, and that at the same time it works quietly. This improvement can also be applied to the ordinary type of steam winch, which can be converted without removing the winch from the ship's deck.

The North Eastern Patent Feed Cleaner and Heater.

This apparatus is designed for the effectual removal of grease, fatty acids and air from feed water by means of centrifugal action without straining the pumps or clogging up the

apparatus. The illustration shows the heater both with the outer casing removed and with the casing in place. The feed water enters at the bottom and rises through a central column, escaping at the top of the column through a fixed turbine. The water is drawn off from the bottom of the heater. Steam circulates through the coils, and the working level of the water



in the heater is maintained by the compression of air in the heater as the heater is filled. A scum valve is provided, discharging into a settling tank, whence it overflows to the hot well. This feed cleaner and heater is manufactured by the North Eastern Marine Engineering Company, Ltd., Sunderland.

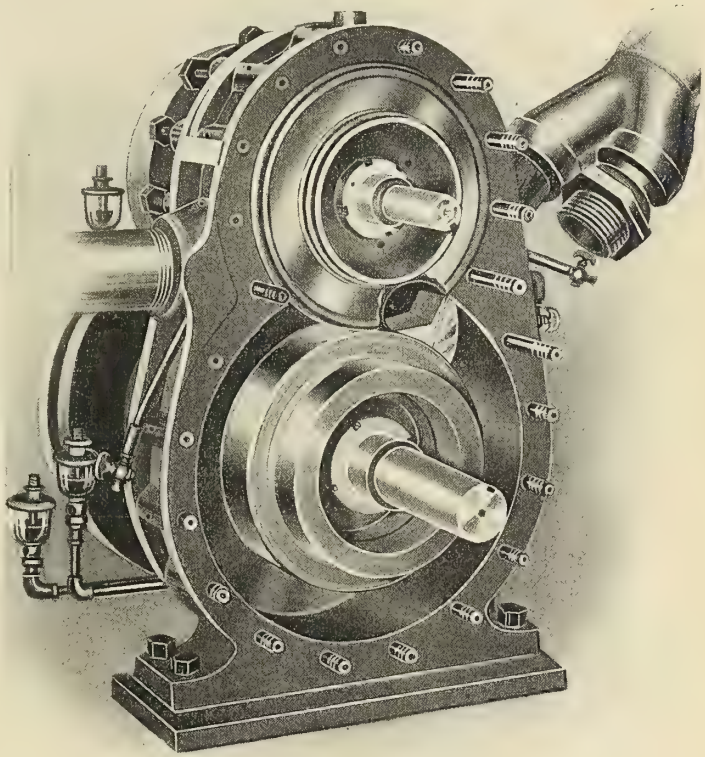
The Herrick Balanced Rotary Engine.

After a long and careful study, Mr. G. P. Herrick, 74 Broadway, New York, has invented a rotary engine which it is claimed fulfills all the requirements of a commercial engine and shows remarkable economy and reliability. The engine differs from all other rotary engines, in that by the use of a newly-discovered counterbalanced bearing it overcomes completely and automatically the friction on its main bearing, due to the radial steam loads. This balancing is accomplished by introducing into a series of stationary balancing chambers a film of steam 1/32 inch thick. These balancing chambers are successively and automatically connected with the cylinder by passages in the rotor. As the piston revolves and the area of the rotor exposed to cylinder pressure increases the counterbalancing area, through the admission of steam through the successive chambers, is equally increased. Thus the primary load and the balancing load are kept equal. As the steam in the cylinder is reduced in pressure through expansion, the pressure in the balancing chambers, which are continuously in communication with the cylinder, is correspondingly reduced.

As shown in the illustration, the engine is a simple steam engine, in which two rotors—an upper rotor to control steam and act as a cylinder abutment, and a lower, a piston rotor—are superposed in rolling contact. The upper rotor contains a recess, which serves as a steam inlet and allows the piston on the lower rotor to pass. The synchronous movement of the rotors is maintained by means of timing gears. Plugs, containing the balancing chambers and a check, are inserted between the rotor and the main bearing. The only points of moving contact in the engine are at the bearings, the rolling contact and the checks in the balancing plug. Power is developed directly along the shaft of the lower rotor.

Steam, admitted to the cylinder through the recess in the upper rotor, both causes the piston to revolve in a continuous circular path and also by exerting counterbalancing pressure in the balancing chambers overcomes through the stroke the radial loads that the cylinder pressure would otherwise exert on the main shaft. The Herrick engine, like the reciprocating type, uses static pressure behind a piston. Like the turbine, it rotates its shaft directly, but uses a single piston instead of many blades on its rotor. It thus combines the steam cycle of the reciprocating engine with the mechanical operation of the turbine.

Steam is admitted to the cylinder chamber behind the piston blade shortly after the blade has left the recess in the upper drum by means of a circular valve. After the required amount of steam has been admitted, the opening in the valve ceases to register with the opening in the cylinder casing, and the steam supply, being cut off, the steam in the cylinder expands against the piston blade rotating the lower drum and the main shaft and also the upper drum and the valve, exhausting after approximately three-quarters of the revolution and just before the piston blade re-enters the recess in the upper drum to pass the abutment.



The casing which forms the cylinder, and incases the drums and rotors, consists of a center body and two side plates. To the side plates, concentric with the upper and lower shafts, are fastened plugs, which enter the annular spaces on each side of the central webs of the drum and between their hubs and annular rings formed on their circumference. These plugs are provided with labyrinth packing and bearings for their respective shafts. They are also provided with chambers on the periphery or outer cylindrical surface of their annular extensions which enter the drums. Each of these chambers at the proper time communicates with the cylinder radially opposite to itself, and is thus provided with steam at the pressure in the cylinder at that point. It is this steam in the chambers which acts as a pressure film and accomplishes the balancing of the radial loads previously mentioned.

The abutment cylinder is packed by a check piece, which prevents steam from passing upward around the drum while the line contact of the surface of this abutment, where rolling on the drum of the rotor minimizes loss in this direction.

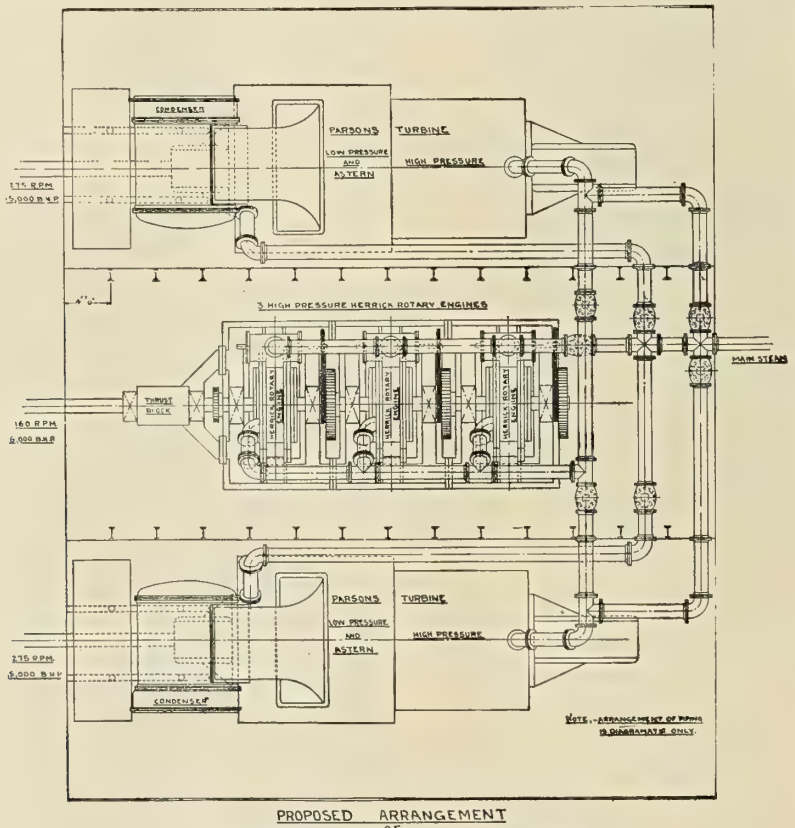
The piston packing is of an approximate contact character. The upper face has a check or tongue piece which slides in a groove from the side and which is limited in its motion in an axial plane by shoulders properly fitted and provided for. Centrifugal force tends to keep this piece out as far as its adjustment permits; but this, if desired, can be augmented by spiral springs in circular recesses beneath the packing strip. The sides of the piston are packed somewhat similarly, but the strips are there necessarily held up by springs as described above. Thus pieces extend radially the full length of the piston and cover the ends of the packing strip on the upper or end face. In all this piston packing actual contact with the cylinder is intentionally avoided, yet without sacrificing seriously in leakage. Where the radial engine is used as the high-pressure unit in combination with low-pressure turbines, the leakage, of course, would be used in the turbine at good economy, but even where there is no opportunity to use the leakage it appears from tests that the energy lost in this way is fairly compensated for by the lack of that piston friction which is usual in reciprocating engines of equal powers.

Tests made on a 20-horsepower engine of this type by Prof. Frederick L. Pryor, of the Stevens Institute of Technology, show the following important features:

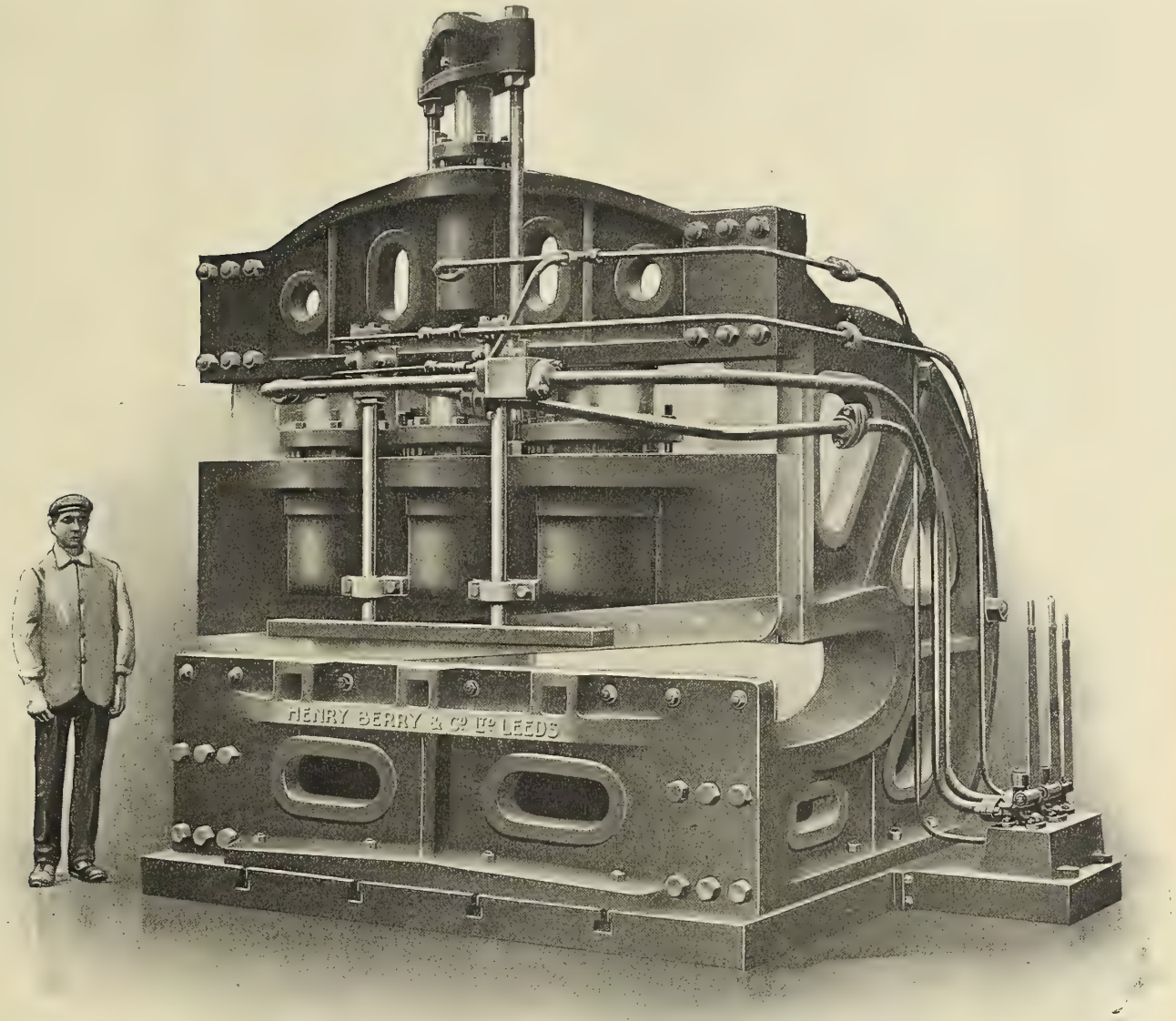
1. The engine ran 1,685 hours out of 2,664 hours.
2. It operated for 66 days of 17 hours each.
3. It operated for 18 days of 24 hours each.
4. It operated consecutively for 149 hours.
5. Only two stops were absolutely necessary, due to trouble with the engine, and these troubles were not serious.
6. The total steam consumption of the engine was not increased, due to the endurance run.
7. The decrease in horsepower and increase in steam consumption per brake-horsepower-hour can be explained by alterations made in the bearings of the engine.
8. The steam consumption of the engine per brake-horsepower is exceedingly good for the size of the engine, and it is equivalent to the steam consumption in many engines of equal power now on the market.
9. The space occupied, the weight of the engine and economy in the engine compared with other engines on the market indicate that the inventors now have a commercial engine.

The steam consumption per brake-horsepower under the best conditions during these tests was 50.7 pounds. On these tests the steam pressure varied from 105.3 to 145 pounds per square inch, the revolutions from 1,000 to 1,012 per minute. The engine ran non-condensing most of the time, and part of the time exhausted into a vacuum of 18.4 inches of mercury.

The engine is peculiarly suited to marine work on account of its small size and weight per horsepower, its low first cost and low cost of maintenance. It is estimated that a 100-horsepower engine will weigh only 4,000 pounds, and as the engine operates with a direct drive at all the advantageous speeds between those of the reciprocating engine and the turbine, its adaptability for marine propulsion is, therefore, evident. It can be easily reversed, eliminates vibration, and can be used for superheated steam and high pressures, and, if desired, can be adapted for compounding. Perhaps the most interesting and valuable possibility of this engine, provided the results obtained with a small engine are maintained when the engine is developed into larger sizes, is its use as the high-pressure stage in connection with low-pressure turbines. One of the illustrations shows a proposed installation of this sort, where a modern battleship requiring about 36,000 horsepower is driven by triple screws. The two wing screws are driven by turbines developing 15,000 horsepower each, and the center screw by a Herrick rotary engine of about 6,000 horsepower. For this combination it is estimated that 10.8 pounds of water will be required per brake-horsepower.



PROPOSED ARRANGEMENT
OF
36,000 B.H.P. MARINE PROPELLING INSTALLATION
3 HERRICK ROTARY ENGINES IN COMBINATION WITH 2 OF PARSON'S STEAM TURBINES
DATE.- 15-APRIL-1910



Large Hydraulic Plate Shears.

The illustration shows a hydraulic plate shear for cutting hard steel plates, two of which were recently supplied to the Italian government by Messrs. Henry Berry & Company, Ltd., Leeds, for use in the dockyards. The machine has all the framing of cast steel, and is mounted on a massive cast iron baseplate; it will cross-cut hard steel plates up to 6 feet 7 inches wide by 1¼ inches thick and of any length. There are three main cylinders, each fitted with turned and polished rams, so arranged that one, two or three rams may be used as desired, thus ensuring considerable economy in the use of pressure water when shearing thin plates. The main slide is of cast steel, carrying the moving shear blade, and is guided by carefully machined and fitted slides on the side frame. The latter are bolted to the baseplate and held rigidly in position by the front shear frame, the crosshead and heavy stays at the rear of the machine. A drawback cylinder, cast in the crosshead, is fitted with a turned and polished ram working through a gunmetal gland with leather packing, which lifts up the shearing slide after making a cut; and two small vice rams are placed at the front of this slide to hold down the plate being sheared.

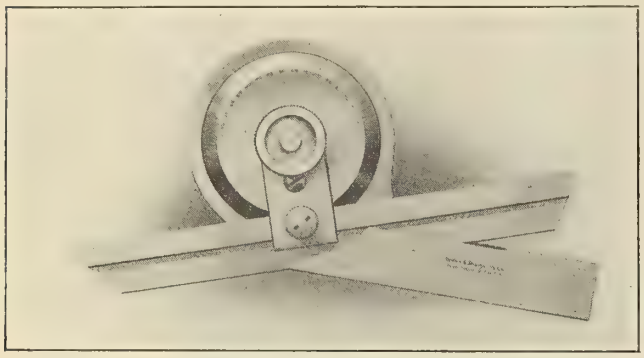
All of the rams for the different movements are controlled by one man from a set of working valves of Berry's Patent B. B. type, which are carried on a stand in a convenient position.

The machines are to work with an accumulator pressure of 1,500 pounds per square inch, and the first one was recently tested at the makers' works in the presence of an inspector for the Italian government by shearing plates 6 feet 7 inches long by 1½ inches thick.

Improved Bevel Protractor.

The improved bevel protractor shown herewith, which was recently put on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I., is an accurate and inexpensive tool for laying out or establishing angles. Not only is it useful to draftsmen but it is also of great service to mechanics. In design the tool is very simple, and is very similar to the improved universal bevel protractor made by the same company. The main point of difference between the two tools is the fact that there is no vernier on the bevel protractor, and so the measurements cannot be made to such a degree of fineness. To facilitate use of the tool one side of the protractor is flat, and this allows the tool to be laid flat on the paper or work, a decided advantage that users of the protractor will appreciate. The dial is graduated in degrees, and these graduations extend over an arc of 180 degrees, reading

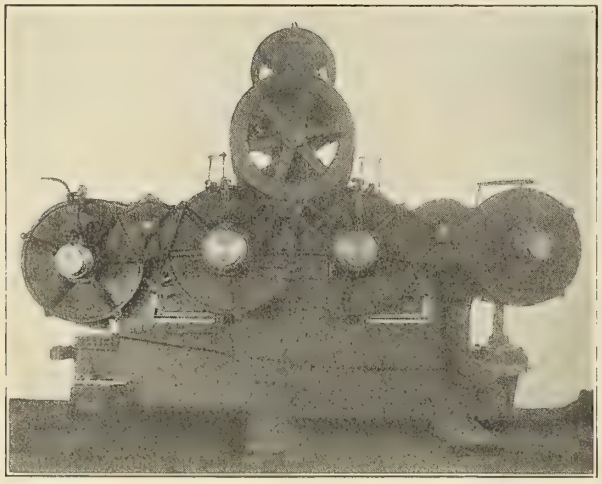
from zero to 90 degrees from each extremity of the arc. Especial care is taken with these graduations to have them accurate. The large central stud upon which the dial of the protractor turns is hardened in order to eliminate as much wear as possible. When the protractor is set and the nut tightened it clamps the dial rigidly in position so that there is no danger of slip. The blade of the protractor is free to move backward



and forward for its entire length independently of the dial, and this adapts it unusually well for work where other protractors cannot be used. It is clamped independently of the dial and is rigidly held in place. Great care has been taken in cutting the grooves, etc., so that there is very little chance for dust to accumulate and cause inaccuracies in the measurements.

Universal Shear for Channels, Angles, and Plates.

The need in ship yards for a machine to cut square or mitred the various channels and angles required for ship building purposes has been met by the machine shown herewith. While especially built for the Marine Department of the Maryland Steel Company, Sparrows Point, Maryland, this machine is intended for any class of iron workers. It is provided with a coping attachment at one end of the ma-



chine; a plate shear at the other; and two angle shears, operating at an angle of 45 inches in the center of the frame. The latter have a capacity for cutting up to 15 inches by ¾ inch channels, and 6 inches by 6 inches by 1 inch or 8 inches by 8 inches by ¾-inch angles. The plate shear has a capacity for 1 inch material. Each shear is controlled by its own clutch, and the machine may be operated by different groups of men all working at the same time, and without interfering with each other. The frame, plunger, pendulums, clutches, and all parts subject to shock are made of semi-steel castings. Hammered steel shafts containing .4 to .5 carbon are used for the shafts, and the question of lubrication has been given special consideration. The gears are provided with long sleeve hubs, and the covers which protect the gears are bored to receive them. The gears in turn support the shafts, which have bearing surfaces throughout their entire length. A patent stop motion is used, which automatically throws out the clutch on each shear when it reaches its highest point. For the coping attachment, which may also be used for punching, the stop mechanism is adjustable so that the plunger may be stopped in any point of its down stroke. It will be noted by the cut that the plates for supporting the angles or channels while being cut are so placed that they are out of the way of plates while being sheared as the latter pass under them. The machine in question weighs about 23 tons. It is driven by a 25 horsepower electric motor, and is manufacturered by the Covington Machine Company, Covington, Virginia and New York.

TECHNICAL PUBLICATIONS.

Corrosion and Preservation of Iron and Steel. By Allerton S. Cushman and Henry A. Gardner. Size, 6 by 9 inches. Pages, 373. Figures, 68. New York, 1910: McGraw-Hill Book Company. Price, $4 net.

This book was written mainly to elucidate the electrolytic theory of corrosion and a considerable portion of it is taken up with the description of results of the researches of one of the authors who has been working in a government laboratory along these lines. The book is not limited to this, however, as the authors have endeavored to include or mention the results of all recent investigations of original researches touching on the subject which have appeared up to the time the book went to press.

Electric Power Plants. By Thomas Edward Murray. Size, 6 by 9¼ inches. Pages, 337. Figures, 152. New York, 1910: The New York Edison Company.

This book is designed to exhibit the engineering details of certain modern electric light and power plants which represent the most advanced design and construction. They comprise the largest stations of the New York Edison Company in the Borough of Manhattan, the new power stations of the Brooklyn Rapid Transit Company, the Gold Street Station of the Kings County Electric Light & Power Company, two stations in smaller cities, one industrial power plant and one hydro-electric plant. The author was the designer of these plants, supervised their construction, and, in the book, he has confined himself to the exposition of facts and of data valuable for the purposes of comparison to the electrical engineer and power station builder.

Sailing Ships and Their Story. By E. Keble Chatterton. Size, 9½ by 7 inches. Pages, 362. Illustrations, 130. Plans, 9. London, 1910: Sidgwick & Jackson. Price, 16/– net.

The book is a history of the development of sailing ships from the earliest times to the present day. Its author is a well-known London journalist who has made yachting his chief hobby. It is not a highly technical work, but was written primarily for the general reader. It will, however, be found a useful reference book, dealing with the sailing ships of different historical periods.

The divisions of the book are very convenient. The first chapter covers early Egyptian ships from about 6000 B. C., followed by an interesting section covering 40 pages on the ancient ships of Phœnicia, Greece and Rome. Early ships of Northern Europe are dealt with in a chapter giving some excellent illustrations of Viking vessels. The development of the sailing ship from the eighth century to the year 1485 occu-

pies some 40 pages; the chapters on the historical periods from Henry VII. to Elizabeth (1485-1603) and from James I. to the close of the eighteenth century bring the subject closer to our own time; the sailing ship in the nineteenth and twentieth century is followed by an excellently written dissertation on the fore and aft rig and its developments; coasters, fishing boats, yachts, etc.

The book is written with a good deal of literary ability, and Mr. Chatterton has gone to considerable pains in securing his material and illustrations.

The Ramparts of Empire. By Frank Fox. Size, 5 by 7½ inches. Pages, 271. Illustrations, 17, full-page, in color. London, 1910: A. & C. Black. Price, 5/- net.

The sub-title of this work is "A View of the Navy from an Imperial Standpoint," and Mr. Fox, who is a writer of Colonial repute, has given an enthusiastic sketch of the navy as he sees it, tracing it from its rise to its present status, and then dealing in two chapters with the new era which has recently begun, viz.: an imperial navy; these two latter sections are divided into "The Subsidy Era" and the "Era of Co-operation."

We understand that the British Admiralty allowed the author special facilities, so that he might obtain an adequate impression of the navy. The book avoids technicalities, and simply aims at giving a picturesque account of England's first line of defense. It is thoroughly up-to-date; an appendix gives details of the naval estimates for 1910-1911.

Told in the Dog Watches. By Frank T. Bullen, F. R. G. S. Size, 5 by 7½ inches. Pages, 332. Illustrations, 2. London, 1910: Smith, Elder & Company. Price, 6/-.

A new volume, by the well-known author of the "Cruise of the *Cachalot*," has appeared with the above title. Some 35 sketches and essays on marine subjects are included, which are quite up to the delightful standard of Mr. Bullen's previous works. It is generally known that the author was formerly an errand boy in London, and went to sea in 1869, where he served in varying capacities up to and including chief mate in all parts of the world. Mr. Bullen is possessed of remarkable gifts, and has turned these to great service in connection with his earlier experiences. We notice that he has no less than twenty-six books to his credit.

The sketches included in this new work deal with a variety of subjects, both grave and gay. Among those of special interest are "Romance of Wreck Raising," "The Sea Changes of Fifty Years," "The Making of a Merchant Service Officer," "Romance of Whaling," and "Life on Board a Battleship." The book constitutes a delightful volume for the leisure hour, and we can recommend it without reserve.

The Navy of Venice. By Alethea Wiel. Size, 5½ by 9 inches. Pages 370. Numerous illustrations. London, 1910: John Murray, Albemarle street, W. Price, 15/-.

The student of marine subjects will find this book particularly interesting, as it deals with the naval history of a city whose rise and fall have given the opportunity to many a novelist and poet. The authoress is the Hon. Alethea Jane Wiel Lawley, the daughter of Baron Wenlock, and she is specially qualified by reason of her long residence and studies in Venice to deal with a subject which up to now has been ignored, or only dealt with in conjunction with other Italian ports.

The present work deals entirely with the Venetian navy in war and commerce during the reign of the Republic. The period from 452 to 943 is covered in the first chapter, which deals with the early Venetians on land and sea. The picturesque rite of the espousal of the head of the Republic with the sea is well described in an interesting way in the section upon "Trade and Pageant and War" (959-1085). A descriptive chapter on the various types of warships, including galleys, quinqueremes, quadriremes and galleons is followed by a section on the Crusades (1097-1130). The chapter which is probably the most interesting one to our readers is that which deals with the arsenal and dockyards, "where the force which generated the power and wealth of Venice lay." Historical chapters follow upon Venice and Constantinople, the Fourth Crusade; "blind old Errico Dandolo," who refused the crown of Byzantium; Venice and Genoa; the War of Chioggia; Venice and the Turks. In this latter chapter Mrs. Wiel hints at the discovery of America having much to do with the decay of the glory of Venice. The last chapters are upon the war with Cyprus (1521-1570), Lepanto (1571), and the War of Candia (1635-1694). The concluding section gives a retrospect of the commerce of Venice—its beginning and decay.

The illustrations are excellent, and well depict the various classes of vessels at different periods; some of these are from models in the arsenal, and others from pictures. Mrs. Wiel aptly says in her preface, "That no work dealing exclusively with the subject has yet been written, is a strange and curious fact—that it should be handled for the first time by a woman, and a foreigner, is stranger still." The book is marked by the literary skill of a clever authoress.

COMMUNICATION.

Development of Battleships.

EDITOR INTERNATIONAL MARINE ENGINEERING:

I read with much interest the description in your May issue of the two battleships recently contracted for by Argentina. They certainly are to be remarkable ships, in that they set a standard which no great nation has yet reached. No plans have been proposed by the British Admiralty, so fas as I have learned, calling for ships equal to the Argentina ships, and I have not learned that Germany has undertaken to build ships equal to them. From what little the cable reports contain regarding the new naval programme of America, it is evident that that government plans to build two battleships inferior to those which are under construction for Argentina.

Why is it that naval authorities lag behind so much in the development of battleships? E. C.

London, W.

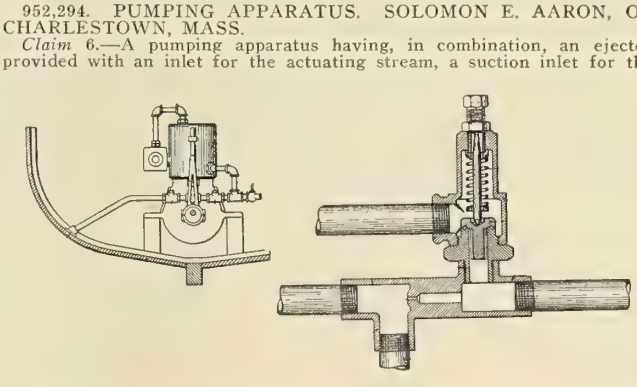
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

952,294. PUMPING APPARATUS. SOLOMON E. AARON, OF CHARLESTOWN, MASS.

Claim 6.—A pumping apparatus having, in combination, an ejector provided with an inlet for the actuating stream, a suction inlet for the



entrained stream, an outlet for the combined actuating and entrained streams, and an outlet between said first and second mentioned inlets; a relief valve connected to said second mentioned outlet, and means

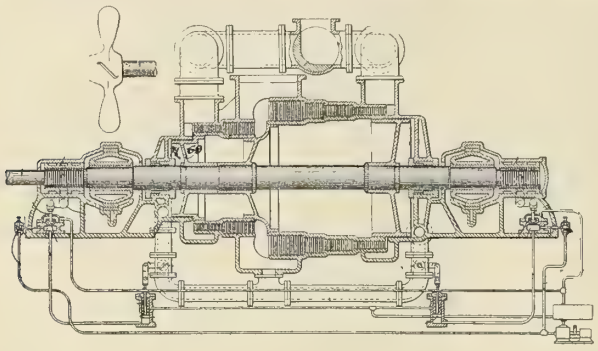
whereby fluid may be supplied to said first mentioned inlet under pressure. Six claims.

951,360. DREDGING MACHINE. NAPOLEON B. BROWARD, OF JACKSONVILLE, FLA.

Claim 1.—In a dredge boat adapted to swing at the bow from side to side of the channel cut, to operate on the whole surface at the end of the cut, a hollow cylinder rotatable in fixed bearings on the forward end of the boat and arranged with its bearings in a substantially vertical line said cylinder having openings into the interior of the cylinder, and exterior cutters for removing the soil and directing it to the interior, means for rotating the said cylinder, and means for exhausting the soil and water. Five claims.

953,530. END-THRUST APPARATUS FOR FLUID-PRESSURE TURBINES. FRANCIS HODGKINSON, OF EDGEWOOD PARK, PA., ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

Claim 1.—In combination with an elastic fluid turbine, a piston carried at one end of its rotor, a chamber behind said piston into which steam passes from the inlet end of the turbine, a passage between said chamber



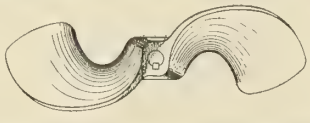
and the turbine exhaust port, a valve in said passage, a fluid pressure actuated device for operating said valve and means dependent upon the rotor end thrust for controlling said device. Eleven claims.

953,283. MEANS FOR EXPELLING THE GAS-ENGINE EXHAUST OF SUBMARINE BOATS. LUDWIG NOÉ, OF KIEL, GERMANY, ASSIGNOR TO FRIED. KRUPP AKTIENGESELLSCHAFT GERMANIAWERFT, OF KIEL-GAARTEN, GERMANY.

Claim 2.—A process of expelling the exhaust gases of gas-engines during the submarine travel of diving boats, consisting in storing the gases and expelling them at great and irregular intervals of time. Three claims.

954,053. PROPELLER. HENRY F. SHAW, OF BOSTON, MASS.

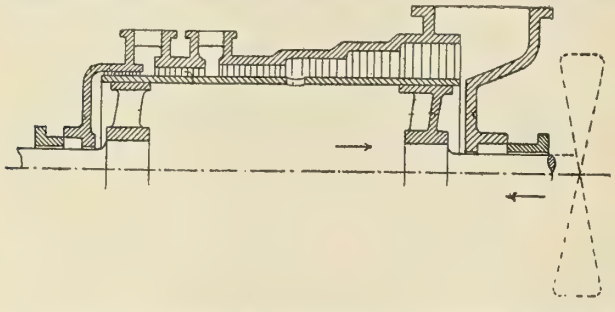
Claim.—A propeller having a coned hub larger on its fore end than on its aft end, and blades whose working surfaces leave the hub as a surface tangent to the surface of the said hub and continuing therefrom constituting coned surfaces, said coned surfaces of each blade being a



part of the surface of a cone the axis of which is inclined to the axis of rotation of the propeller as described; the aft boundary lines, that is, the aft edge lines of the propeller blades, lie approximately in the surface of a cone the axis of which coincides with that of the rotation of the propeller. One claim.

954,212. BALANCING MEANS FOR TURBINES. CARL ROTH, OF ZEHLENDORF, NEAR BERLIN, GERMANY.

Claim 1.—In combination, a propeller shaft, a turbine drum on said shaft, a casing around said drum, a steam inlet and an exhaust outlet on said casing, blading on said drum and casing on one side of said inlet, a labyrinth packing on said drum and casing on the other side of said



inlet, a closed disk within said turbine drum, an overload inlet on said casing, a connection from an intermediate point later in the expansion of the steam than said overload inlet, and opening to the interior of the drum on one side of said closed disk and on the opposite side of the labyrinth packing to the steam inlet, said disk being on its other side subjected to the pressure of the exhaust. Two claims.

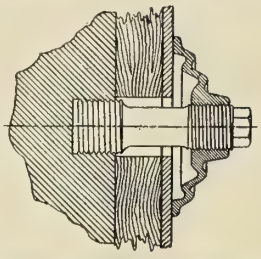
953,694. LAUNCHING APPARATUS. CHARLES HUNT, OF NEW YORK, N. Y., ASSIGNOR OF ONE-FOURTH TO JASON ROGERS, OF ESSEX FALLS, N. J.

Claim 1.—A launching for boats, comprising a support for the life boat, davits mounted to turn, tackles held on the said davits and connected with the said life boat, a manually controlled driving shaft, and mechanism for actuating the said support, the davits and the tackle from the said driving shaft. Nine claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

3,688. MEANS FOR SECURING ARMOR PLATES TO WARSHIPS. G. RUSO, ROME, ITALY.

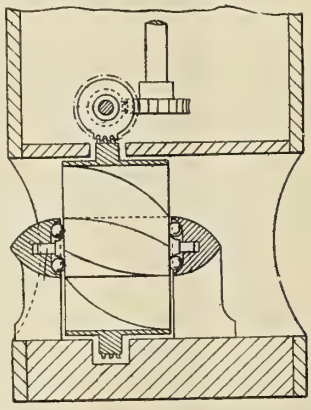
This invention has for its object to provide differential screw-bolts with an elastic cup-shaped washer for the purpose of lessening or obviating injury to the bolt under the jarring effect of a blow upon the armor and of preventing parts of a broken bolt being violently projected into the interior of the ship, and avoiding the use of a special



protecting cap, intermediary washers of rubber or other perishable material, while reducing the weight and space ordinarily required for the usual fastening means. Accordingly differential screw-bolts are used in conjunction with the cup-shaped washer forming the nut of the bolt.

4,811. SHIP'S LOGS. W. C. FORBES AND J. STARNES, LONDON.

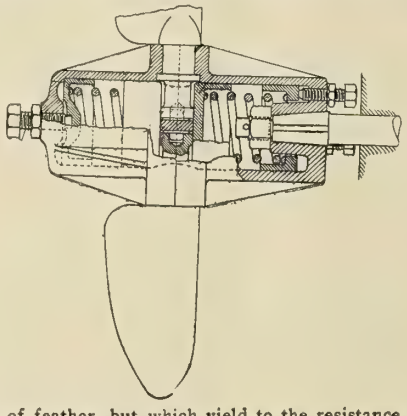
According to this invention, the rotator or fan for actuating the indicating mechanism through a shaft is mounted on a horizontal axis in the end of a housable cylinder and is extended through a sea-valve into the



dead water, which thus operates the rotation. This construction gives reliable records at low speeds. Modified forms of rotators or fans are described.

7,084. SCREW PROPELLERS. A. G. TAYLOR, LONDON.

According to this invention, the blades are each formed with a spindle end in alignment with the forward edge of the blades and projecting into a hollow boss. Here the spindles have cams which are acted upon by springs which may tend to keep the blades in a normal position of



steep pitch, or of feather, but which yield to the resistance of the water within certain limits. The arrangement is such that the angle assumed by the blades varies according to the resistance, so that a more equal propelling effect is produced and boring obviated.

10,083. MARINE SIGNALING APPARATUS. DR. J. SCHIESSLER, BADEN, AUSTRIA.

The main object is to provide apparatus for picking up syntonized sound signals under water and by which the distance of a source of sound or of a point remote from the observer can be readily determined according to the principle which consists in measuring the time between the arrival of light waves, i. e., electrical waves, and sound waves sent out simultaneously, after hich the distance of this source or point from the observer is determined by a simple calculation of the time measured, multiplied by the velocity of sound. To this end the apparatus comprises five circuits: I. The microphone circuit. II. The circuit of the telephone relay. III. The inductive telephone circuit. IV. The circuit of the electrical chronometer, and V. The circuit of the hearing receiver of a wireless system.